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DRAFT
Characterization Analysis Report
Weather Deck Runoff

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DRAFT

CHARACTERIZATION ANALYSIS REPORT

DECK RUNOFF DISCHARGES

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Naval Sea Systems Command
U.S. Department of the Navy

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1.0 INTRODUCTION

Deck runoff was defined as the precipitation, washdowns, and seawater falling on the weather deck of a vessel and discharged overboard through deck openings in 40 CFR 1700.4 (1999). A vessel intermittently produces deck runoff when water falls on or is applied to the exposed surfaces, such as weather and flight decks, superstructure, bulkheads, and the hull above the waterline of a vessel (e.g., freeboard and bulwark). Discharge constituents vary depending on the vessel's topside processes, and may include oil, grease, petroleum hydrocarbons, surfactants, cleaning compounds, glycols, solvents, salt, and particulates (e.g., soot, dirt, or metallic particles). All vessels generate deck runoff.[1]

The Uniform National Discharge Standards (UNDS) deck runoff shipboard assessment team (referred to hereafter as the 'survey team') visited 13 vessels representing 9 different Navy and U.S. Coast Guard vessel classes to determine how various topside processes contribute to deck runoff within 12 nautical miles (nm) of the U.S. and territorial coastlines. The survey team, comprised of three topside equipment experts, conducted pierside and at-sea assessments to observe and document topside equipment and processes, cleaning practices, and their associated materials. In addition, the survey team solicited crew input regarding potential methods to reduce or eliminate discharge constituents.

Prior to performing the shipboard assessments, the survey team conducted a comprehensive evaluation of all vessel classes regulated by UNDS. All vessels listed in the document *"Ships Applicable to UNDS – Vessel Class Listing with Number of Vessels per Class (Active Vessels Only)"* were analyzed to determine similarities (Wenzel, et. al., 1999). The evaluation considered vessel mission, topside equipment, weather deck surface area, age, and number of vessels in each class. Based on the evaluation, each class of vessel was placed into one of nine platform categories: (1) air capable, carrier; (2) air capable, amphibious assault; (3) surface combatant; (4) auxiliary; (5) service craft; (6) towed support; (7) patrol/small craft; (8) submersible; and (9) research vessel.

The survey team developed a list of class-specific topside processes and equipment having the potential to contribute to deck runoff. All information concerning the topside processes was compiled to identify specific classes of vessels to survey; ensuring data were obtained multiple times on each topside process. A copy of the class-specific process matrix is provided in Appendix A. After compiling the list, the survey team determined that vessels representative of the towed support, submersible, and research vessel categories would not be surveyed. The rationale for this decision was: (1) these vessels do not have unique topside equipment; (2) these vessels do not perform unique maintenance processes topside; and (3) a survey of these vessels would not be expected to provide unique data. The survey team presented the survey approach to the UNDS Deck Runoff Discharge Assessment Team (DAT), comprised of representatives from the Navy (USN), U.S. Coast Guard (USCG), and the Environmental Protection Agency (EPA), and obtained their concurrence.

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[1] *Water from precipitation, washdowns, and seawater that falls on or is applied to exposed surfaces and accumulates in the lowest part of the vessel is classified as surface vessel bilgewater. Associated characterization analyses are presented in the Surface Vessel Bilgewater Characterization Analysis Report.*

In an attempt to obtain anecdotal quantitative as well as qualitative data, the survey team queried each sailor performing maintenance on topside equipment regarding the amount of materials used as well as the amount that is exposed to the environment following completion of the maintenance process. Unfortunately, responses varied significantly during the first two shipboard assessments. For example, one survey team member asked a sailor how much grease he had applied to a 5" gun chase; his response was 2 oz. The survey team then queried several sailors who were also working on the gun mount; responses ranged from 2 oz to 1 lb. Because the grease on the gun chase was exposed, the survey team was able to visually examine the gun chase and concluded that it contained approximately 1 lb of grease. These types of discrepancies occurred several times when investigating different maintenance processes. The survey team concluded that quantitative data obtained during shipboard surveys for material exposed to the environment would only be documented when a survey team member could verify the estimated amount. The survey team again presented this finding and recommendation to the UNDS Deck Runoff DAT and obtained their concurrence. To ensure the survey team could accurately estimate the amount of material exposed to the environment, they conducted laboratory tests designed to provide a visual baseline for comparison purposes. These tests were conducted at Naval Surface Warfare Center, Carderock Division (NSWCCD). The tests involved visual calibrations of liquid spills and grease dispersions. Typical grease guns were used to determine the quantity of grease that would be dispersed with one, two, or three pumps on the handle of the gun into a grease fitting. In addition, varying quantities of liquids, such as JP-5 (MIL-DTL-5624T), were spilled on deck surfaces to allow the observers to better quantify their visual assessments. The results were not exact, but this exercise provided a common baseline for all observers (Wenzel *et al*., 2001a).

This characterization report is organized into the six main categories that contribute to deck runoff. Each category is comprised of one or more related processes that occur topside on Armed Forces vessels. Within each category, this report provides a brief explanation of the processes included in that category, summarizes the observations of the survey team; and presents the constituent contribution, where available, from each process. The report presents the performance objective, as defined in the topside management plan (TMP), and possible activities that could be performed to achieve that objective for each category. For the purposes of deck runoff, an objective describes the desired potential controls and expected results. Finally, the report provides a qualitative discussion of the constituents to be controlled by each activity.

When reviewing this characterization report, it is important to recognize the following:

- Constituents that fall to the deck from a variety of activities may become trapped in the rough deck surface (defined as crevices, corners, and other irregularities of a deck surface), even after clean up attempts, and these residuals may subsequently become entrained in washwater and/or rainfall and wash overboard within 12 nm. A field study to determine quantifiable amounts for these residual constituents was deemed impractical by the survey team and the Deck Runoff DAT. Some of the data presented in this report are estimates based on survey team observations.

- Information was obtained on each identified process until the survey team reached a consensus that enough data had been gathered to be representative of the Fleet. Once a consensus was reached, the survey team ceased gathering data related to that specific process on subsequent shipboard assessments. For example, data on small boats were not gathered during the final assessments (LHD 1 and CV/CVN 68 Class vessels).

- The following sections summarize the observations of the survey team. However, due to individual vessel operational scenarios, maintenance requirements and practices, the observations may not be representative of all vessels in the same vessel class.

- The primary information identified for some materials is information contained in the military specification (mil spec) or the material safety data sheet (MSDS). Proprietary compound's bulk constituents therefore are listed as unknown.

2.0 AIRCRAFT LAUNCH AND RECOVERY EQUIPMENT (ALRE)

Aircraft carriers are the only vessels that have aircraft launch and recovery equipment (ALRE) for fixed wing aircraft. This equipment consists of arresting gear for recovering aircraft, catapults for launching aircraft, and jet blast deflectors to divert jet engine exhaust from the flight deck.[2]

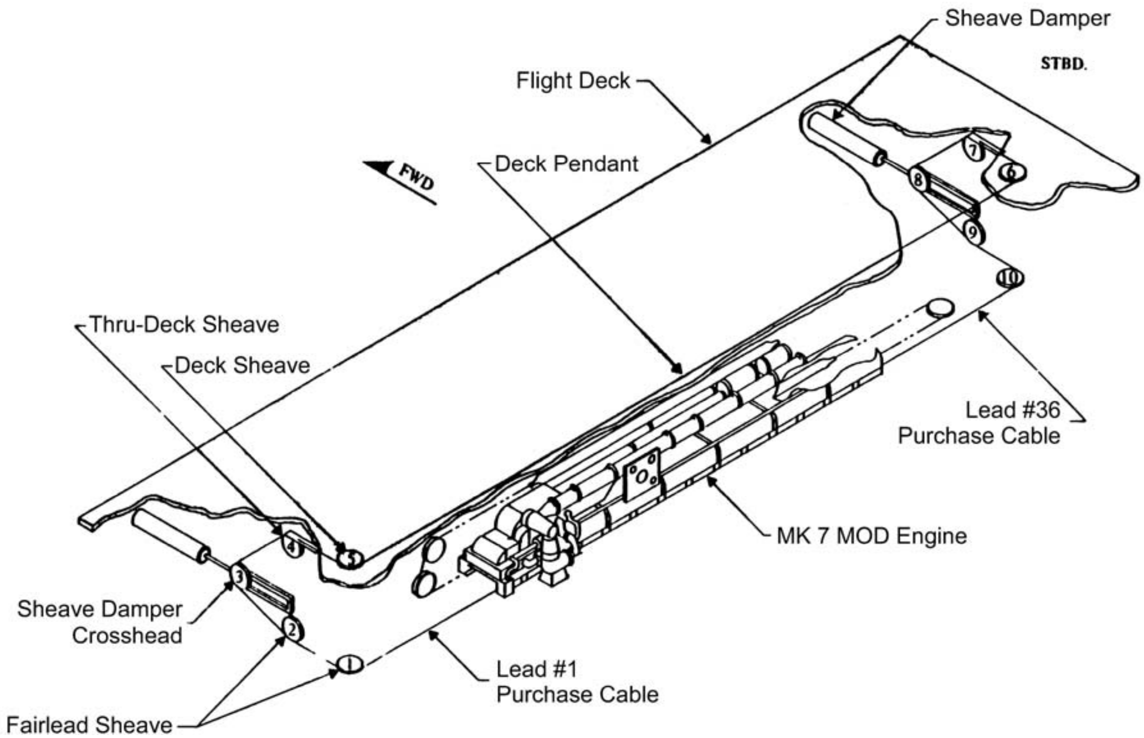
Materials used to maintain the catapults and jet blast deflector enclosures have the potential to enter surrounding waters. The catapult trough enclosure drains present the largest potential for contribution to deck runoff. The design and open track slot of the catapult trough serves as a collection point for all constituents used topside, including aircraft fuel, hydraulic fluid, soot, rain, sea water, and drainage from flight deck washdown evolutions. In addition, the accumulated materials in the barricade stanchion wells and retractable sheave enclosure areas in the arresting gear also have a potential to enter surrounding waters. These areas serve as collection and discharge points for deck runoff; however, most of these discharges occur outside 12 nm during flight operations because the ALRE is disconnected and stowed when not in use. Due to a number of variables such as, number of aircraft launched/recovered, operating temperatures, frequency and amount of rainfall, frequency and amount of "green water" (sea water that washes onto the deck in rough seas), and amount of material used when performing maintenance (each person applies a different amount because no quantity is identified on the maintenance requirement card) (Wenzel *et al*., 2001a), there is insufficient process knowledge to arrive at a plausible estimate.

2.1 ARRESTING GEAR

Arresting gear equipment includes: sheave dampers, fairlead sheaves, barricade stanchions, and various deck equipment (Wenzel *et al*., 2001a) (See Figs 2-1 thru 2-3).

[2] *Amphibious assault ships (LHD 1 and LHA 1 Classes) carry AV-8B Harrier aircraft. These fixed wing aircraft are vertical and short take-off landing (V/STOL) capable and do not require catapults.*

Figure 2-1. Arresting Gear Diagram



The cross deck pendant arresting wires are located on the flight deck. The aircraft tail hook engages one of these four wires. Each cross deck pendant is engaged to a purchase cable which is lead from the arresting gear engine up to the flight deck by a series of grooved pulleys called sheaves. The cutaway diagram shows the arresting gear engine, the system of pulleys, and the cross deck pendant. (Image courtesy FAS Military Analysis Network.)

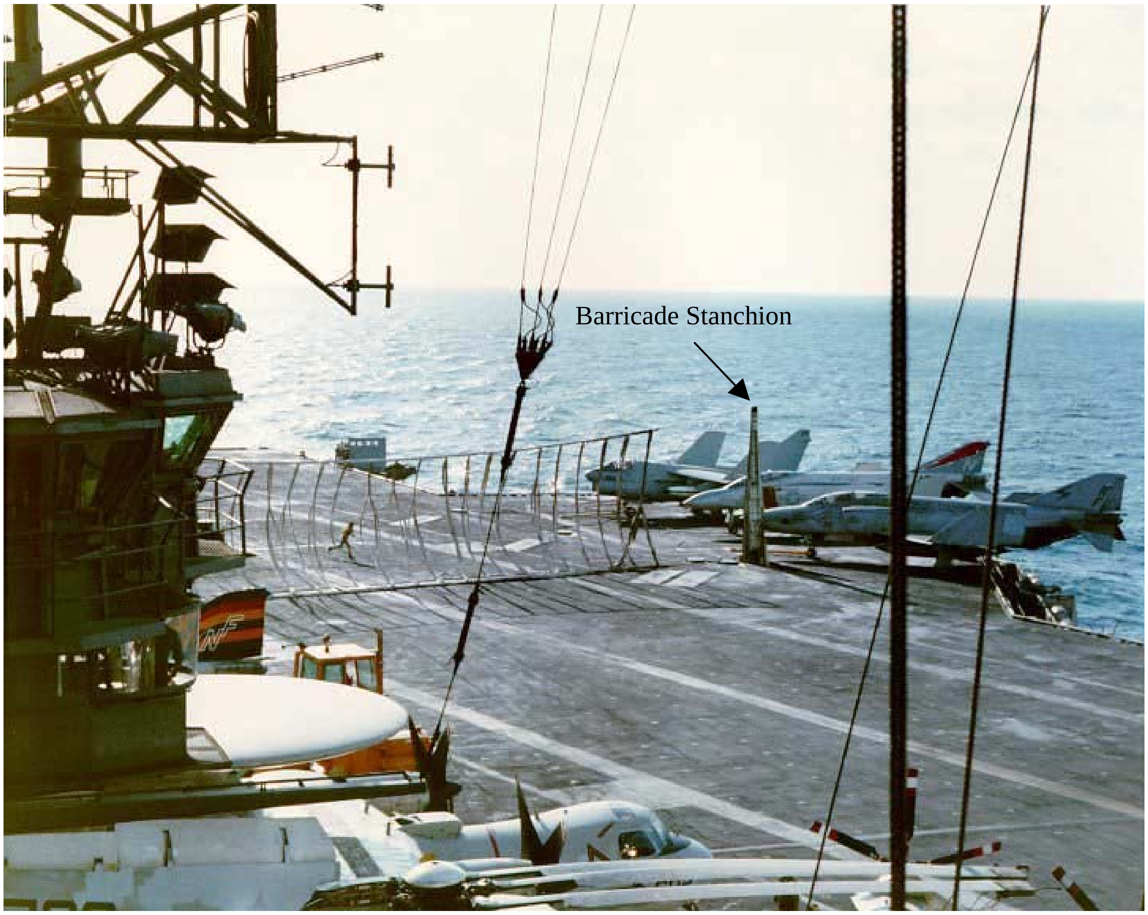
<u>*Sheave Dampers*</u>. The sheave dampers are located on the 03 level (the third level above the main deck of the ship) immediately below the flight deck and the retractable sheave. The primary function of the sheave damper is to absorb the initial peak shock from the aircraft engaging the arresting gear wire. The damper also guides the arresting gear engine purchase cable to the flight deck. The sheave damper components do not contribute to deck runoff (Wenzel *et al*., 2001a).

<u>*Fairlead Sheaves*</u>. The fairlead sheaves guide the arresting gear engine purchase cable from the engine to the sheave damper assembly prior to transiting to the flight deck. The fairlead sheaves do not have the potential to contribute to deck runoff (Wenzel *et al*., 2001a).

<u>*Barricade Stanchions*</u>. The barricade stanchions are housed flush in the flight deck and are used to rig and raise the aircraft emergency barricade recovery nylon webbing assembly (See Figure 2-2). When raised to the full vertical position, the barricade stanchions are 22 ft high. Each stanchion houses two-cable winch assemblies used to tension the barricade webbing. The cables are stainless steel and require no lubrication. The winch assembly gears and stanchion pivoting pins are greased using small amounts of Mobilgrease 28 arresting gear grease (MIL-PRF-81322F). The stanchions are raised hydraulically using the hydraulic cylinder located in the barricade stanchion well. The grease on the tensioning winches and pivoting pins may wash off

during heavy rainfall or during exterior topside surface washdown evolutions; however, the amount is negligible (Wenzel *et al*., 2001a), and the barricade stanchions are rarely in the raised position within 12 nm.

Figure 2-2. Emergency Landing Barricade



This figure shows the emergency-landing barricade set up prior to conducting an emergency aircraft recovery. This system is used in place of the normal arresting gear cross deck pendants, which are retracted prior to deploying the barricade. The landing barricade is used to recover crippled aircraft that cannot make use of the arresting cable. (Photograph by Steve Harr.)

Deck Equipment. Deck equipment includes retractable deck sheaves, wire supports, barricade stanchion components, crossdeck pendant (arresting gear wire), and purchase cable. The gravity drains for the barricade stanchion components and the retractable deck sheaves discharge directly overboard. The retractable deck sheaves guide the arresting gear wire as it retracts following an aircraft recovery. The maintenance materials that have a potential to enter surrounding waters include: Mobilgrease 28 arresting gear grease (MIL-PRF-81322F), Grikote 31EP lubricating oil (no military specification), dry cleaning solvent MIL-PRF-680 type III, and A-A-59313 anti-seize compound. Grikote 31EP is based on a synthetic ester oil with extreme pressure additives (Wenzel *et al*., 2001a).

Figure 2-3. Arresting Gear

Arresting Gear showing retractable deck sheave housing
(Navy photograph by H. Dwain Willis.)

The following tables list the potential discharge materials and narrative parameters observed by the survey team. No quantitative data were available. Constituents remaining on deck surfaces are cleaned during exterior topside surface washdowns. Although residual amounts may contribute to deck runoff, quantitative data were not available. Table 2-1 provides information gathered from Material Safety Data Sheets for the particular Military Specification number listed. No further information is available (Wenzel *et al.*, 2001a).

Table 2-1— Potential Discharge Materials for Arresting Gear

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Arresting Gear Grease (e.g., Mobilgrease 28) (MIL-PRF-81322F)	Unknown	Synthetic oils	—	> 70	Unknown	Unknown
		Additives	—	< 30	Unknown	Unknown
		Sodium nitrite	7632000	Unknown	Unknown	Unknown
Lubricating Oil (Grikote 31EP)	1.7E+03	Petroleum hydrocarbons	—	Unknown	Unknown	Unknown
Anti-seize Compound (A-A-59313)	Unknown	Zinc dust	7440666	42	Unknown	Reduction
		Petroleum grease	8009038	58	Unknown	Unknown
Dry Cleaning Solvent 6850-00-274-5421 (MIL-PRF-680 Type III)	Unknown	High purity hydrocarbon solvents	64771728	100	Unknown	Unknown

BCC = bioaccumulative contaminant of concern
*Note: Information was obtained from military specifications for each material used on the arresting gear. In many cases, different compounds conform to the listed military specification, each having its own material safety data sheet.

Table 2-2— Narrative Parameters for Arresting Gear

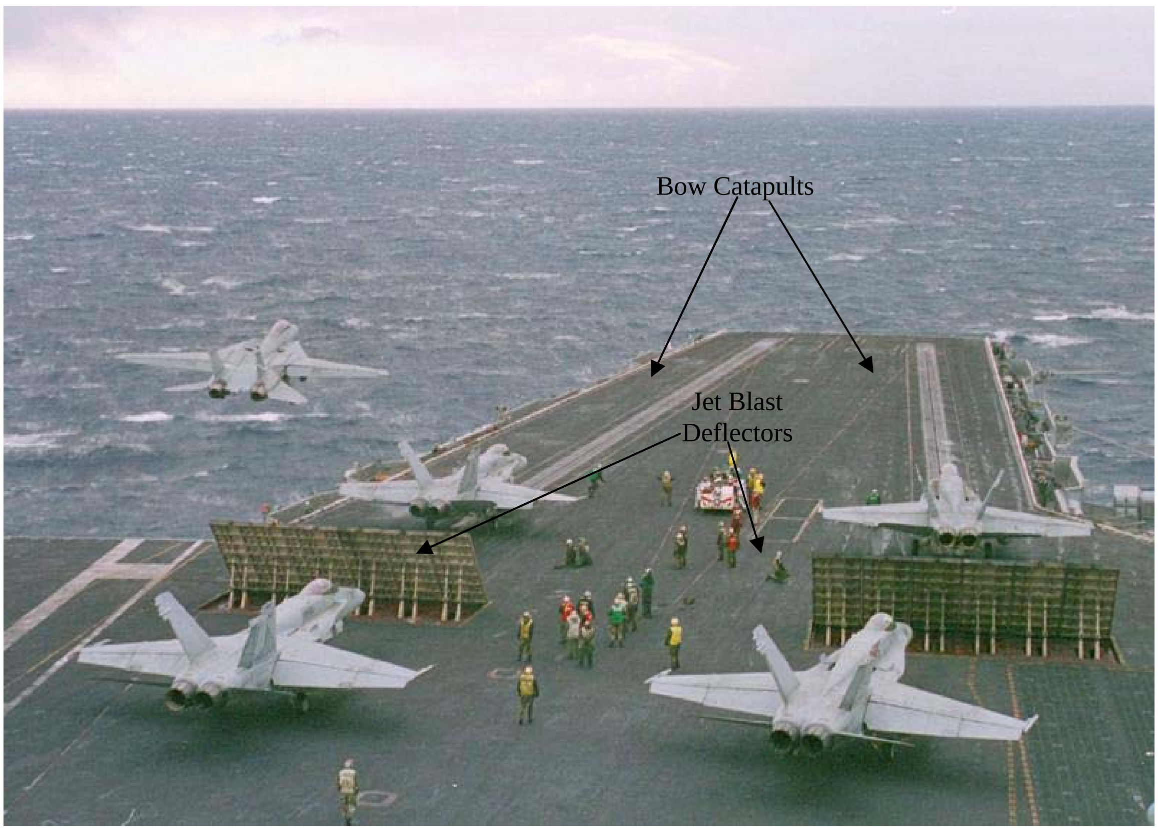
Narrative Parameter	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Unknown-not evaluated
Hardness	Unknown-not evaluated
Nutrients	Unknown-not evaluated
Odor	Unknown-not evaluated
Oil and Grease	Unknown-not evaluated
Pathogens	Unknown-not evaluated
PH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Unknown-not evaluated
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of assessment. The information is based on survey team recollection and consensus.

2.2 CATAPULT OPERATIONS

__Catapults.__ All active carriers are equipped with four steam-powered catapults and associated deck equipment. Each catapult consists of a catapult slot, a control system, and launching and retraction engines. (Wenzel *et al*., 2001a) (See Figure 2-4). A drainage system collects fluids from these engines along with deck runoff water and discharges them near the waterline. This system consists of a trough directly under the catapults to collect the fluids and drainage lines, equipped with duplex strainers, that discharge overboard near the waterline.

Figure 2-4. Catapults with Jet Blast Deflectors



Four F/A-18 *Hornets* wait to launch from the bow catapults of the *USS Enterprise*. The figure shows the bow catapults with jet blast deflectors raised. The catapult has a relatively narrow slot opening in the deck. The catapult trough lies beneath this slot. Each catapult includes two steam cylinders fitted with pistons that provide the motive force for the system. These pistons are fitted to a shuttle that is, in turn, connected to the nose landing gear of the aircraft. Each catapult trough is approximately 5 ft wide, almost 4 ft deep, and approximately 340 ft long. (Navy photograph by Benjamin D. Olvey.)

__Launching Engine.__ The launching engines are located beneath the catapult slots and are enclosed by the catapult trough, which is located immediately below the flight deck. Materials used to maintain and preserve the launching engine equipment have the potential to enter surrounding waters through the catapult drain system. These materials include Aeroshell Grade 120 lubricating oil (SAE J1899), DOD-G-85733 high temperature grease (Bel Ray HT), and MIL-

PRF-680 Type III degreasing solvent. MIL-PRF-680 Type III degreasing solvent is a dry cleaning solvent composed of high purity hydrocarbon solvents (kerosene and alkyl benzenes). The 120 grade lubricating oil is a mixture of 96.5 % petroleum hydrocarbons, 3 % polymethacrylate, and 0.5 % inhibited phenol antioxidant. Approximately 55 % of this oil produces a sludge that makes up approximately 96 % of the material accumulated in the catapult trough that can contribute to deck runoff during heavy precipitation and produce a sheen and floating materials (Opet, 2000; Wenzel *et al*., 2001a).

Control System. The control system for the catapult includes the deck edge launching control station, jet blast deflector control panel, center deck control station, and the integrated catapult control station (ICCS). The control system does not have the potential to contribute to deck runoff (Wenzel *et al*., 2001a).

Retraction Engine. The retraction engine for the catapult is located in the catapult machinery spaces adjacent to the catapult trough. The retraction engine's four cables are connected to the grab assembly located in the catapult trough. The retraction engine provides a means of returning the catapult shuttle and launching engine piston assembly to the battery position in preparation for the next launch. The cables and grab assemblies, which travel in and out of the trough area, are cleaned using MIL-PRF-680 Type III degreasing solvent, and lubricated with DOD-G-85733 high temperature grease. Both products have the potential to enter surrounding waters through the catapult trough drain (Wenzel *et al*., 2001a).

Drainage System. The drainage system begins with a trough that encloses the launching and retraction engines. At several locations in the floor of the trough, drainage pipes collect free liquid and channel it through duplex basket strainers that filter out debris. The drainage pipe travels down through the ship's interior and exits just above the waterline. Normally, open damage control valves are in the line adjacent to where it passes through the hull. Greases and oils from the launching and retraction engines, or from deck top sources can collect on the surfaces of the trough, in the drain lines, or in the strainer. Also, debris that collects in the strainer can be oil or grease coated. Water passes through the drain system, which includes deck runoff draining into the catapult slots and steam condensing on the trough, can pick up constituents from oils and greases and carry them overboard. In addition, bulk quantities of oil can potentially collect in puddles and flow into the drains as the ship rolls.

Associated Deck Equipment. Other deck equipment related to catapult operations includes catapult-launching accessories. Oil and greases used to maintain and preserve this equipment are normally applied to the equipment below decks; therefore maintenance activities do not contribute any constituents to deck runoff (Wenzel *et al*., 2001a). Flight deck operations of deck equipment has the potential to contribute constituents to the deck surface, depending on equipment operating environment, age, and physical condition of the equipment.

Each aircraft carrier is equipped with four catapults. There are two different models of catapults, Mod 1 and Mod 2 (CVN 72 to CVN 76), which use 0.415 gal and 0.83 gal of SAE J1899 per catapult launch, respectively. Based on operating experience, 0.10 gal (for Mod 1) and 0.42 gal (for Mod 2) are discharged overboard via the catapult trough and its drainage system during each catapult cycle. In addition, some lubricating oil is carried with the catapult piston into the water brake tank where it is periodically skimmed off the top of the water and discharged overboard outside 12 nm.[3] Steam that escapes through the trough slot during operations beyond 12 nm can potentially carry small droplets containing or consisting of oily constituents that can fall to the deck and eventually contribute to deck runoff. The following tables indicate the potential discharge materials and narrative parameters observed by the survey team. Significant amounts of materials will collect in the catapult troughs and contribute to deck runoff via the catapult trough drain system; however, quantitative data were not available. Constituents remaining on deck surfaces are cleaned during exterior topside surface washdowns; however, residual amounts may contribute to deck runoff.

Table 2-3— Potential Discharge Material for Catapult Operation

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Grease (Bel Ray HT) 9150-01-145-1259 DOD-G-85733	3.3E+3	Antimony compound	—	< 1	< 3.3E+1	None
		Molybdenum compound, insoluble	—	10	3.3E+2	None
		Graphite, natural	7782425	5	1.7E+2	None
Aeroshell Grade 120 9150-00-753-4937 SAE J1899	6.4E+3	Mineral oil/ petroleum distillates	—	40 - 50	2.6E+3 - 3.2E+3	Unknown
		Hydrotreated oil	—	50 - 60	3.2E+3 - 3.9E+3	Unknown
Dry Cleaning Solvent 6850-00-274-5421 MIL-PRF-680 Type III	Unknown	High purity hydrocarbon solvents	—	100	Unknown	Unknown

*Note: Potential Discharge Volume varies with operational speed and frequency, temperature, and weather conditions.

[3] *This discharge will be addressed separately under UNDS (Catapult Water Brake Tank and Post Launch Retraction Exhaust) (EPA and DOD, 1999).*

Table 2-4—Narrative Parameters for Catapult Operation

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists
Hardness	Unknown-not evaluated
Nutrients	Unknown-not evaluated
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
Pathogens	Unknown-not evaluated
PH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment. The information is based on survey team recollection and consensus.

2.3 JET BLAST DEFLECTORS

Each of the four catapults has a jet blast deflector to deflect the high velocity and high temperature exhaust away from personnel and equipment on the flight deck. The areas of the jet blast deflector that require lubrication are contained within the jet blast deflector enclosure. The sources of deck runoff constituents from jet blast deflectors include lubricating oil (NSN 9150-01-432-0511), grease (NSN 9150-00-823-8047, MIL-G-23549), anti-seize compound (NSN 8030-00-292-1102, A-A-59313), and accumulated jet exhaust soot. The enclosure drains are equipped with a strainer basket that is cleaned prior to entering port, during quarterly maintenance, and as required. Examples of conditions that would require the strainer basket to be cleaned include an accumulation of constituents resulting from heavy rain, flight deck washdown, or fuel spill near the jet blast deflector (Wenzel *et al*., 2001a).

The following tables present the potential discharge materials and narrative parameters observed by the survey team, however, quantitative data were not available. Constituents remaining on deck surfaces are cleaned during exterior topside surface washdowns; residual amounts may contribute to deck runoff (Wenzel *et al*., 2001a).

Table 2-5— Potential Discharge Material for Jet Blast Deflectors

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Grease (GP) 9150-00-823-8047 MIL-G-23549	Unknown	Petroleum hydrocarbons	—	Unknown	Unknown	Unknown
Oil, Lubricating 9150-01-432-0511 (No mil spec)	984	Unknown	—	Unknown	Unknown	Unknown
Anti-seize Compound 8030-00-292-1102 A-A-59313	Unknown	Zinc	7440666	58	Unknown	Reduction
		Petrolatum	—	42	Unknown	Unknown
Jet Exhaust Soot	Unknown	Unknown	—	Unknown	Unknown	Unknown
Dry Cleaning Solvent 6850-00-274-5421 MIL-PRF-680 Type III	Unknown	High purity hydrocarbon solvents	—	100	Unknown	Unknown

*Note: Potential discharge volume varies with operational speed and frequency, temperature, and weather conditions. A full analysis was not conducted on jet exhaust soot, but may contain carbonaceous material, sulfates, and by-products of incomplete combustion of JP-5.

Table 2-6—Narrative Parameters for Jet Blast Deflectors

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Unknown-not evaluated
Hardness	Unknown-not evaluated
Nutrients	Unknown-not evaluated
Odor	Unknown-not evaluated
Oil and Grease	Unknown-not evaluated
Pathogens	Unknown-not evaluated
PH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Unknown-not evaluated
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment.

2.4 PERFORMANCE OBJECTIVE AND ACTIVITIES

The objective for aircraft launch and recovery equipment is for the vessel's responsible party to prevent the discharge of oils, greases, solvents, soot, and other materials associated with ALRE that may negatively impact water quality. Activities that could be performed to meet this performance objective include, but are not limited to: minimizing catapult test launches in port; cleaning and stowing ALRE before transiting within 12 nm; and using an "environmentally compliant"[4] lubricant for catapults or other equipment associated with ALRE.

Catapult no-load testing is required after performing various maintenance actions (e.g., activities involving the launch, hydraulic and/or electrical control systems) to ensure system integrity and safe flight operations (Navy, 1997a). Naval Air Warfare Center Aircraft Division Lakehurst mandated the following procedures to minimize test launches in port: no-load shots in port should be limited to ten, and lubrication shall be activated on the first shot only with the piston assembly in the battery position. If additional no-load shots are required, the previously described process should be repeated with lubrication applied only during the first shot (Navy, 1997d). This activity reduces the number of catapult test launches, thereby reducing the discharge of oil, grease, and soot to deck runoff.

When CV/CVNs plan to be in port for an extended period of time, the arresting gear is disconnected and stowed below decks. When the vessel is going to transit within 12 nm, the cross deck pendant is disconnected from the purchase cable and laid alongside the flight deck. The loose purchase cable is then retracted into the sheave damper spaces (Alexander, 2001). This activity prevents the grease, oil, and anti-seize compounds from contributing to deck runoff. Also, before the CV/CVNs return to port, the catapult trough drain strainer baskets are cleaned and the catapult track slot-seals are installed, which closes off the catapult track slots. This cover protects the catapult from damage while not in use and prevents water from entering the trough, therefore preventing the introduction of additional constituents to deck runoff. The barricade stanchion is cleaned upon returning to port. This cleaning prevents barricade stanchion constituents from contributing to deck runoff.

The Navy is currently implementing an engineering change to replace the currently used catapult lubricant with an "environmentally compliant" catapult lubricant. This engineering change is being implemented on all CV/CVN Class vessels (Weeks, 2001). The "environmentally compliant" catapult lubricant has been tested and evaluated both ashore at Naval Air Warfare Center Aircraft Division Lakehurst and at sea, on CVN 70 (Opet, 2000). [[Removed sentence per Navy comment]] All CV/CVN Class vessels will perform this activity when the elimination of the non-environmentally compliant lubricant is complete. Using environmentally compliant catapult lubricant will reduce the amount of oil residue deposited in the catapult trough by 96 %; thereby reducing the amount of oil contributing to deck runoff (Opet, 2000).

[4] *Environmentally compliant for this activity, as defined in ECP1-CAT-00130 (Grajek, 2000), means the product meets the requirements set forth in Annex I of Marine Pollution (MARPOL), the Act to Prevent Pollution from Ships (APPS), and the Clean Water Act (Opet, 2000).*

3.0 BUOY MAINTENANCE

The survey team conducted an assessment of the buoy handling systems aboard a WLM 175 Class vessel on June 9, 1999. USCG WLM/WLB Class buoy tenders retrieve, maintain, and reset navigational buoys, primarily inside 12 nm. Navigational buoy servicing consists of (1) buoy retrieval and re-deployment, and (2) inspection, cleaning, and maintenance. Major repairs, including full buoy repainting, are conducted at shoreside facilities (Wenzel, 2000e).

3.1 CLEANING COMPOUNDS

Simple Green™ is the only cleaning compound used during the buoy maintenance. The cleaner is applied to the solar power panel using a spray bottle and immediately removed with a clean rag. All other cleaning is conducted with a high-pressure washer (seawater) and mechanical scrapers. The survey team concluded cleaning agents used in the buoy handling/cleaning process do not contribute to deck runoff (Wenzel *et al*., 2001a).

3.2 PAINTING AND PRESERVATION

The manufacturer's instructions for navigational buoys require paints used for submerged service to comply with MIL-P-24647. All exterior steel surfaces above the waterline must meet the requirements listed in the Commandant Instruction (COMDTINST) M10360.3B, Chapter 16. These specifications establish that paints shall comply with volatile organic compounds (VOC) requirements (no more than 340 g/L) and be free of lead and chromium (a mass fraction of less than 0.06% for either metal) (U.S. Coast Guard, 1998, 1999, 2000b). During buoy manufacturing, two coats of epoxy primer, each with 5 mils dry film thickness, are applied to the buoy's external surfaces. One topcoat of paint is used for above waterline surfaces. Polyurethane paints are used for a topcoat on ionomer foam and steel ocean buoys (3 mils dry film thickness), and epoxy acrylic paints are used on unlighted steel river buoys (1.5 mils to 2.0 mils dry film thickness). Two coats, each 5 mils thick, of ablative antifouling paint (MIL-P-24647) are applied to all below-the-waterline exterior surfaces.

Because most of the paint is located below the waterline, it is assumed that most paint chips consist of primer and antifouling ablative paints. These ablative antifouling paints contain a mass fraction of approximately 47 % copper as copper (I) oxide (cuprous oxide) and a mass fraction of approximately 15 % zinc as zinc oxide.

Buoys, which are used for navigational and weather observation purposes, are maintained both inside and outside 12 nm, with the majority of buoys inside 12 nm. Buoys, along with their sinkers and anchor chains, are raised from their position in the water and hauled on deck using cranes and cross-deck winches. Once on the vessel's deck, the buoys, sinker, and chain are cleaned, inspected, repaired, preserved, and subsequently returned to their position. Buoys are cleaned using a scraper and seawater with a high-pressure washer. The non-paint chip component of the debris consists of rust, biological material (e.g., epiphytic algae and invertebrates), marine bird and mammal excrements, and sediments (e.g., mud and sand) attached to the buoys, concrete sinkers, and steel chains. The precise composition of this material cannot be ascertained because it is temporally and spatially variable. Some of the debris cleaned from the buoy is made of neutrally buoyant material (e.g., filamentous algae, and soft body invertebrates) with a density close to 1 g/ml that can remain suspended in the water column when it is washed off the deck. Other debris is heavier (e.g., encrusting algae, barnacles, and sediments) and will sink through the water column.

Rust, biological material, sediment, and paint chips resulting from buoy cleaning and washing are pushed overboard using shovels and a 3,000 psi pressure washer using seawater supplied by the vessel's 160 psi firemain system. Constituents found in this discharged material are likely to include biological materials, rust, and weathered paint chips (including metals and biocides contained in the buoy paints). Although the survey team was unable to estimate the exact composition, they observed that sediment and biological materials comprises more than 99 % of this mixture (Wenzel *et al*., 2001a). When a buoy-tending vessel conducts maintenance and preservation on a buoy that is going to be reset in the same place that it was hauled in from, the vessel stays as close as it safely can to the haul-in/deploy location. If the buoy is going to be transported to a buoy overhaul facility, an overhauled or new buoy will be deployed in its place. Using a hose, the crew washes the loose biofouling material off of the buoy to be transported, as it is hauled aboard. The buoy is then chained down so the new buoy can be deployed resulting in only one loose buoy at a time. Once the deployment is complete, the crew will turn their attention to cleaning the remaining biofouling materials from the newly hauled buoy. If another buoy in the vicinity is to be hauled and deployed, the crew may postpone cleaning the previously hauled buoy as they prepare for the next haul-in. Buoy tending vessel operators depend on this flexibility to be able to efficiently tend to the buoys in their area of responsibility. If the next buoy to be hauled is only 500 yards up the river or bay, it may be more efficient to haul and deploy the next buoy while the weather and vessel traffic are favorable to operations. This may delay the final biofouling material cleaning of the previously hauled buoys. However, as long as the biofouling material is discharged in the same “ecological area” (as defined in the deck runoff environmental effects analysis report (EEAR)), the potential to transport non-indigenous species (NIS) is eliminated (Volpe, 2002a).

All major repainting is performed off vessel; occasionally minor touch-up painting is performed underway during the buoy maintenance process. During the day of the assessment, none of the six buoys retrieved required touch-up painting. Based on interviews with crewmembers, the survey team concluded that touch-up paint does not contribute constituents to deck runoff (Wenzel *et al*., 2001a).

As noted above, based on the survey team’s visual observations, more than 99 % of the mixture was sediment and marine growth; less than 1 % of the mixture appeared to be rust and paint chips. The fleet-wide discharge of biological materials, sediment, rust, and paint chips from buoy maintenance is calculated as follows (Wenzel *et al*., 2001a).

a. The survey team visually estimated the volume of biological materials, sediment, rust, and paint chips removed from an average sized buoy to be approximately 4 gal per service episode. The USCG fleet of WLM/WLB buoy tenders is responsible for a total of 9,000 buoys. USCG regulations require each buoy be inspected and serviced, if needed, at least every two years. USCG estimates that approximately 10 % of the buoys will be moved off station or damaged by storms each year. These buoys require inspection and servicing prior to resetting. Therefore, the USCG typically services approximately 5,400 buoys each year.

b. Estimating that 5,400 buoys are inspected each year and approximately 4 gal of biological materials, sediment, rust, and paint chips are released per buoy; approximately 21,600 gal of biological materials, sediment, rust, and paint chips are potentially released as deck runoff annually.

c. Based upon an assumption that less than 1 % of the marine sediment mixture is paint chips, the annual paint chip release can be estimated at less than 216 gal.

d. The current fleet of WLM and WLB (33 hulls) services approximately 5,400 buoys annually (Navy, 2002). A WLM 175 services approximately six navigational buoys during each maintenance day (Wenzel, 2000a). After each buoy is serviced, the working deck is washed for approximately 5 min with a 3 gal/min pressure washer, resulting in approximately 90 gal/day of water being discharged. At the end of each day, the buoy deck is washed for approximately 20 min with a 3 gal/min pressure washer and a 100 gal/min standard nozzle hose supplied by the firemain. The volume generated during the end-of-day 20 min wash is more than 2,000 gal. In summary, the daily liquid discharge volume from buoy and working deck washdowns onboard a WLM 175 is approximately 2,150 gal. Assuming that each buoy tender services approximately 164 buoys annually, and six buoys are serviced in a day, each buoy tender spends approximately 28 days per year maintaining buoys. This results in an annual discharge volume of more than 60,000 gal per vessel.

Information presented in the following table is based on the survey team's observations; information obtained from MSDSs based on those observations; and military specifications listed in the COMDTINST M10360.3B, Color and Coatings Manual.

Table 3-3— Potential Discharge Materials for Buoy Operations

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Paint chips/debris	1.0E+02 (estimated)	Copper as cuprous oxide	7440508	47	5.1E+01	Reduction
		Zinc as zinc oxide	7440666	15	1.6E+01	Reduction

Table 3-4— Narrative Parameters for Buoy Operations

Narrative Parameter	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	No change noted.
Floating Material	None observed; however, the potential does exist.
Hardness	Sediment is indigenous to the waters it is retrieved from/returned to.
Nutrients	Unknown-not evaluated
Odor	Unknown-not evaluated
Oil and Grease	None observed, paint chips would not cause a sheen.
Pathogens	Unknown-not evaluated
PH	Unknown-not evaluated
Settleable Materials	None observed; however, the potential does exist.
Specific Conductance	Unknown-not evaluated
Suspended Solids	None observed, but unlikely to exceed 25 mg/l daily average.
Taste	Unknown-not evaluated
Temperature	Does not change temperature.
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment. The information is based on survey team recollection and consensus.

3.3 PERFORMANCE OBJECTIVES AND ACTIVITIES

The performance objective for buoy maintenance is for the vessel's responsible party to prevent the discharge of rust, paint chips, paint drips, cleaning compounds, and other materials associated with buoy maintenance that may negatively impact water quality. An additional objective of buoy maintenance is to prevent transporting non-indigenous or invasive species with fouling material and sediment released during buoy maintenance operations. Activities that could be performed to meet this performance objective include, but are not limited to: using high-pressure washes; conducting only minor buoy repairs underway; and discharging biofouling material and sediment from where the buoy was pulled.

Using a focused, high-pressure washer with a 3,000 psi water stream to remove marine biofouling during buoy cleaning evolutions reduces the amount of loose paint chips and loose rust removed compared with using a scraper. Using the pressure washer minimizes the need for scraping; thereby reducing the contribution of paint chips and rust to deck runoff.

Performing only minor paint removal, various repairs (e.g., structural welding), and touch-up preservation reduces the amount of paint chips, rust, and paint drips on the deck where they could potentially contribute to deck runoff. Buoys that require major painting or repair are transferred to shore where major maintenance is performed.

During routine buoy cleaning, biofouling organisms and sediment are washed from the buoys. This material is deposited on the deck. This activity involves discharging this material in the same "ecological area" (as defined in the deck runoff environmental effects analysis report

(EEAR)) as to where the buoy is stationed. Discharging to the location of origin could reduce the risk of transporting non-indigenous species to sensitive areas. All Armed Forces vessels conducting buoy maintenance perform this activity.

4.0 CLEANING ACTIVITIES AND GENERAL HOUSEKEEPING

Cleaning and general housekeeping include aircraft washdowns, electronic intelligence/navigational systems, equipment and vehicle washdowns, exterior topside surface washdowns, and firemain systems. The following paragraphs provide more details on each of these processes.

Aircraft washdowns include cleaning the exterior surfaces and engines of fixed and rotary wing aircraft. The washdown effluent may contain traces of fuel, dirt, salt, hydraulic fluid, lubricating oil, soot (from ship's main propulsion unit), greases, and aircraft cleaning compound. Depending on the vessel class, this effluent is either vacuumed off the deck and discharged overboard or discharged directly overboard. For Navy vessels, aircraft washdowns occur outside of 12 nm and are not regulated by UNDS. However, some of these compounds may become trapped in rough deck surfaces and residual amounts may contribute to deck runoff within 12 nm. For USCG vessels, the majority of aircraft washdowns occur outside 12 nm; the effluent discharges directly overboard.

The survey team determined that the maintenance of electronic intelligence/navigational systems evaluated on AOE 6, DDG 51, MCM 1, WLM 175, and WPB 110 Class vessels did not contribute to deck runoff. However, on the MCM 1 Class vessels, a small amount of cleaning compound is used to clean navigational system components and could contribute to deck runoff.

Equipment and vehicle washdowns may contribute dirt, salt residue, oil and grease, and cleaning compounds to deck runoff. Although most cleaning evolutions are performed outside 12 nm, residuals trapped in rough deck surfaces may contribute to deck runoff within 12 nm.

Frequency and types of exterior topside surface washdowns vary with vessel class and geographic location (inside/outside 12 nm). When in port, the effluent is either collected and contained for disposal or discharged directly overboard according to standard operating procedure for USCG, . When underway, several cleaning protocols are used. They include flight deck and hangar deck SCRUB X exercises (see Section 4.4.2 for detailed explanation) and a mechanical flight deck scrubber. Flight deck and hangar deck SCRUB X exercises occur well outside 12 nm and the mechanical flight deck scrubber removes any residual solution. The washdown effluent may contain salt residue, rust, oil and grease, traces of fuel, soot, hydraulic fluid, aircraft tire residue, paint chips, cleaning compounds, and other materials. This solution is then discharged overboard.

Finally, the firemain system, which supplies water for some deck cleaning activities, does contribute to deck runoff. However, the constituents contributed by this system are being evaluated separately under UNDS (EPA and DOD, 1999).

4.1 AIRCRAFT WASHDOWN

Aircraft washdowns include cleaning the exterior surfaces and engines of fixed wing and rotary wing aircraft. Aircraft washdowns remove dirt, salt, hydraulic fluid (MIL-PRF-83282D), lubricating oil (MIL-PRF-23699FF), and grease (MIL-PRF-23827C and MIL-PRF-81322F).

Aircraft hydraulic fluid (MIL-PRF-83282D) consists of more than 65 % of synthetic hydrocarbon base oil and less than 35 % of lubricant ester base. Aircraft grease (MIL-PRF-81322F) is mostly a complex mixture of paraffinic, napthenic and aromatic hydrocarbons, while MIL-PRF-23827C grease is 75 % to 85 % synthetic ester, 10 % to 15 % lithium 12-hydroxystearate, 1 % to 2 % antimony dialkyldithiocarbamate, and 1 % p,p'-dioctyldiphenylamine.

Exterior surfaces of fixed wing aircraft are cleaned with freshwater and a solution of aircraft cleaning compound (MIL-PRF-85570C Type II, see table 4-3 for bulk constituents). On aircraft carriers (CV and CVN Class designation), fixed wing aircraft are washed every 14 days, while on amphibious assault vessels (LHD 1 and LHA1 Classes), fixed wing aircraft are washed every 7 days. The wastewater and cleaning solution is continuously vacuumed from the deck while the washdown is conducted. All washdown wastewater is subsequently discharged overboard when the vessel is operating outside 12 nm. Because aircraft depart the vessel before it transits within 12 nm, fixed wing aircraft are not washed inside 12 nm.

A complete freshwater washdown of Navy rotary wing aircraft is performed every seven days (Wenzel, 2000e; Wenzel *et al*., 2001b, 2001c). The washdown procedure calls for approximately 8 oz of aircraft cleaning compound (MIL-PRF-85570C Type II) for every 1 gal of freshwater. The aircraft is wetted down and rinsed using an unknown quantity of freshwater. The washwater and aircraft cleaning compound mixture drains directly overboard. Before and after rotary wing aircraft washdowns, all aircraft fittings are greased.

USCG rotary wing aircraft are washed every day while underway with a solution of VCI-415 cleaning compound in freshwater (U.S. Coast Guard, 2000a, 2001a). The aircraft is wetted down and rinsed using less than 500 gal of water. The USCG WAGB 420 and 399, WHEC 378, WMEC 270, and WMEC 210 Class cutters (42 total) do operate within 12 nm. However, their operational time within 12 nm is less than 10 % of their total underway operational time. Each WHEC and WMEC cutter typically carries one rotary wing aircraft onboard, WAGBs typically carry two. The wastewater generated drains directly overboard.

All USCG and most Navy vessels that are expected to accommodate two or less rotary wing aircraft are designed with a flight deck that can only accommodate one of the aircraft at a time. If the vessel carries a second aircraft, it must remain in the hangar while there is an aircraft on the flight deck. The aircraft on the flight deck is positioned above a device called a "TALON" grid. This is the position that the aircraft must takeoff and land from. Additionally, any maintenance not conducted in the hangar, is conducted in this position. The TALON grid is an approximately 10 ft to 16 ft diameter circular and flush deck grid that the aircraft's hold-down device hooks into. The grid has a cavity beneath it that drains directly overboard. The grids are always greater in diameter than the aircraft's fuselage. Therefore, any constituents that may drip from the aircraft's fuselage, forward landing gear, or result from fuselage/engine washing or refueling activities, drip/drain directly into the TALON grid cavity. Washwater from those areas of the aircraft (nose and tail sections) that are not over the TALON grid does end up on deck. However, these sections do not contribute constituents of significance because of their enclosed and limited machinery. Due to the vessel motion experienced by these smaller vessels, and the closeness of the aircraft to the deck drains, aircraft washwater quickly drains overboard. One example is the WHEC 378 foot cutter, which has a beam (width) of only 38 feet. With the aircraft centered over the TALON grid, the aircraft washwater needs to travel less than 19 feet to reach the deck edge, and less than that to reach a drain. On these smaller vessels, aircraft washwater (which may contain soap or other constituents) on the deck, combined with vessel motion create an unsafe work environment for personnel. The crew typically rinses any aircraft washwater, left on deck at the conclusion of the aircraft wash, to the deck drains or deck edge (Volpe, 2002b).

The difference between Navy and USCG rotary wing aircraft washdown schedules is due to their different operating profiles. USCG vessels that carry rotary wing aircraft are typically much smaller than Navy vessels that carry rotary wing aircraft. Because USCG vessels are smaller than Navy air capable vessels and often lack a hangar, the aircraft are exposed to more sea spray than on larger vessels. To prevent premature corrosion of vital aircraft components, the aircraft on USCG vessels are washed more frequently than on Navy vessels.

Fixed wing and rotary wing aircraft engines are cleaned with cleaner MIL-C-87937D (a mixture of 1 % to 5 % 2-butoxyethanol, 1 % to 5 % cyclohexanol, and 20 % to 40 % aromatic hydrocarbons) or gas path MIL-C-85704C Type I or IIA cleaner (a mixture of approximately 10 % dipropylene glycol methyl ether, 10 % hexylene glycol and unknown amounts of heavy aromatic naphtha, triethanolamine, and nonylphenol polyethoxate), both of which are mixed with water. Rotary wing aircraft engines and rotors are rinsed with freshwater after each flight. The frequency of engine wash with gas path cleaner depends on the type of aircraft and vessel location. Although USCG rotary wing aircraft engines may be washed within 12 nm of the U.S. coast, the vast majority of those washes occur outside 12 nm because when USCG vessels are operating within 12nm they typically do not have aircraft embarked. Fixed wing aircraft engines are cleaned outside 12 nm. Appendix L of OPNAVINST 5090 (Navy, 1999) explicitly states that wastewater from aircraft engine washdowns can only be disposed overboard when outside 12 nm. Navy aircraft engine waterwash produced within 12 nm must be containerized for shore disposal.

Aircraft washdown evolutions were observed and documented during the AOE 6, CV/CVN 68, and LHD 1 Class shipboard assessments. The following sections cover class specific characterizations, whereas the previous paragraphs describe the possible constituents that could contribute to deck runoff in general. The following sections are based upon findings by the survey team, and although not necessarily representative of all vessels in a particular class, these findings are assumed to be representative unless otherwise noted.

4.1.1 AOE 6 Class

For the AOE 6 Class of auxiliary support vessels, aircraft washdowns are dependent upon flight operations and location. Freshwater washes are performed after all flights over salt water to remove salt deposits. These freshwater washdowns focus on the windshield and rotor assembly, and normally take only 2 min using a 0.75 in garden hose at 20 psi with a nozzle attached. Although the hose is equipped with an on/off nozzle, it is left in the "on" position so the crewmember can spray the helicopter as they walk from the front to the back of the aircraft. A complete freshwater washdown is performed every 7 days. However, if operations are conducted in the Persian Gulf region, the helicopters are washed every 3 days due to the accumulation of sand on the aircraft. When a complete washdown is performed, the aircraft is washed using approximately 8 oz of MIL-C-87937D aircraft cleaning compound mixed with 1 gal of freshwater. If the aircraft is extremely dirty, two gal of the solution (or 16 oz of MIL-C-87937D) may be required. During complete washes, the freshwater is applied using a 150 psi pressure washer and a 0.75 in garden hose. The washwater/aircraft cleaning compound mixture drains directly overboard. While on the AOE 6 Class, the survey team observed the crew capturing a portion of the washwater from the top of the aircraft to wash the lower portion of the aircraft (Wenzel *et al*., 2001a).

Upon returning from each flight, a freshwater rinse is performed on the engines and rotors to remove salt accumulation. The helicopter engines are washed every 25 hr of flight operation and every 14 hr when operating at-sea. The engines are washed with a mixture of MIL-C-85704C aircraft cleaning compound and freshwater. This mixture is poured over and into the engine, and then flushed with freshwater until all visible signs of soap are removed from the engine compartment. The runoff travels down the side of the aircraft directly onto the helicopter deck (Wenzel *et al*., 2001a).

Because the aircraft are not onboard when the vessel is operating in the contiguous zone, the discharges generated as a direct result of aircraft washdown are not regulated by UNDS. However, residual MIL-C-87937D and MIL-C-85704C that have become trapped in the rough deck surface have the potential to subsequently become entrained in rainfall and contribute to deck runoff within 12 nm (Wenzel *et al*., 2001a).

4.1.2 CV/CVN 68 Class

For the CV/CVN 68 Class, both rotary and fixed wing aircraft washdowns are dependent on operational tempo (i.e., rate of operations or aircraft activities) and vessel location. While the aircraft are attached to the vessel and in an underway operating status, a complete freshwater washdown is performed every 14 days, with the exception of the SH-60 helicopter that is washed every 7 days. Spot washing is conducted daily, as required, using an aerosol aircraft cleaning compound (mil spec unavailable). When a complete washdown is performed, the aircraft is washed using aircraft cleaning compound MIL-PRF-85570C Type II. Freshwater is supplied using a 0.75 in garden hose with a spray nozzle attached. Approximately 100 gal to 150 gal of water are used per aircraft. MIL-PRF-81322F grease is applied via the grease fittings prior to the washdown evolution to expel old grease and again after the washdown to expel grease contaminated with the washwater. Based on laboratory testing conducted by the survey team, the survey team estimated that in excess of 1 g of grease is expelled each time the grease gun is pumped. The crew told the survey team that aircraft grease fitting is lubricated by pumping the grease gun 3 – 4 times; therefore, the survey team concluded that approximately 4 g to 5 g of grease is used per fitting prior to and after each washdown for a total of approximately 8 g to 10 g per fitting per washdown. The expelled grease falls to the flight deck and is recovered with the washwater and discharged overboard with the washwater outside 12 nm (Wenzel *et al*., 2001a).

For all fixed wing aircraft, all aircraft engines are cleaned by washing the engines with MIL-C-85704C gas path cleaner. After completing the engine wash, the engines are rinsed using freshwater. The freshwater is supplied from the vessels' freshwater system using a 0.75 in garden hose with spray nozzle attached. To prevent the water and gas path cleaner from spreading to other areas of the flight deck resulting in unsafe conditions, the crew uses wet vacuums to contain this washwater. This water/detergent mixture is subsequently discharged overboard. As previously noted, these operations are conducted outside 12 nm (Wenzel *et al*., 2001a).

For all rotary wing aircraft, engines are washed using MIL-C-85704C gas path cleaner every 60 hr of flight operations. The engines are rinsed using freshwater. The freshwater is supplied from the vessels' freshwater system using a 0.75 in garden hose with spray nozzle attached. Although the gas path cleaner and rinse water run onto the flight deck, squadron personnel use wet vacuums to prevent the water and cleaning solution from spreading to other areas of the flight deck resulting in unsafe conditions. This water/detergent mixture is subsequently discharged overboard outside 12 nm (Wenzel *et al*., 2001a).

Although all aircraft disembark when the vessel is well beyond the contiguous zone, MIL-PRF-81322F aircraft grease and MIL-PRF-85570C aircraft cleaning compound may become trapped in the rough deck surface after exterior topside surface washdown. Subsequently, this residual matrix may contribute to deck runoff within 12 nm (e.g., during rain events) (Wenzel *et al*., 2001a).

4.1.3 LHD 1 Class

For the LHD 1 Class, aircraft washdowns are dependent upon the vessel's location and operational tempo. Freshwater washes are performed daily, when underway, to remove salt deposits. The washdown lasts 2 min and is performed using a 0.75 in garden hose at 20 psi with a spray nozzle attached. A freshwater rinse is also performed on aircraft that have flown over water at altitudes less than 500 ft for extended periods. MIL-PRF-81322F grease is applied via the grease fittings prior to the washdown to expel old grease and again after the washdown to expel grease contaminated with the washwater. Based on laboratory tests and observations, the survey team determined that approximately 8 g to 10 g of grease is used per fitting; each helicopter has 10 grease fittings. The expelled grease falls to the flight deck and is discharged overboard with washwater outside 12 nm (Wenzel *et al*., 2001a).

Each aircraft receives a complete freshwater washdown every 7 days. During the complete washdown of an AH-1 aircraft, the crew mixed approximately 8 oz of MIL-PRF-85570C aircraft cleaning compound with three gal of freshwater, and applied the mixture to the aircraft using long telescoping poles with a flat scrubbing head. A 0.75 in garden hose with a spray nozzle attached was used to wet and rinse the aircraft. The entire process took 40 min, with the water running for 14 min. The wastewater drained directly overboard (Wenzel *et al*., 2001a).

For all fixed wing aircraft, the engines are washed every 25 hr of flight operations using MIL-C-85704C gas path cleaner and water solution. The mixture is poured over and into the engine, and then flushed with freshwater until all visible signs of soap are removed from the engine compartment. A pneumatic wet vacuum cleaner is used to contain and recover the cleaning compound/water mixture; the recovered mixture is subsequently discharged overboard. These operations are conducted outside 12 nm (Wenzel *et al.*, 2001a).

Rotary wing aircraft engines are also cleaned using MIL-C-85704C gas path cleaner. The mixture is poured over and into the engine, and then flushed with freshwater until all visible signs of soap are removed from the engine compartment. A pneumatic wet vacuum cleaner is used to contain and recover the cleaning compound/water mixture that is subsequently discharged overboard outside 12 nm (Wenzel *et al.*, 2001a).

Although aircraft disembark when the vessel is well beyond the contiguous zone, MIL-PRF-85570C aircraft cleaning compound and MIL-PRF-81322F grease may become trapped in the rough deck surface and subsequently contribute to deck runoff within 12 nm (e.g., during rain events) (Wenzel *et al*., 2001a).

4.1.4 Cleaning Compounds

Aircraft washdown was observed on the AOE 6, CV/CVN 68, and LHD 1 class vessels. MIL-PRF-81322F grease is applied via the grease fittings prior to the washdown evolution to expel old grease and again after the washdown to expel grease contaminated with the washwater. Based on laboratory tests and observations, the survey team determined that each aircraft grease fitting is lubricated with approximately 4 g to 5 g of grease both prior to and after the washdown, for a total of approximately 8 g to 10 g of grease per fitting per washdown. The aircraft washdown data are shown in the following tables.

Table 4-1— Estimated Quantities of Grease Fittings and Cleaning Compounds per Aircraft Washdown

Vessel Class	Aircraft Type	Number of Grease Fittings	Cleaning Compound	Cleaning Compound Amount
AOE 6 Class	All aircraft	10	MIL-C-87937D	8 oz/gal of water
CV/CVN 68 Class	F-14	85	MIL-C-81302 Type II	2.5 gal
CV/CVN 68 Class	F/A-18	60	MIL-C-81302 Type II	1.5 gal
CV/CVN 68 Class	S-3	100	MIL-C-81302 Type II	2.5-3 gal
CV/CVN 68 Class	SH-60	10	MIL-C-81302 Type II	32 oz
LHD 1 Class	All aircraft	Unknown	MIL-PRF-85570C, Type II	0.5 gal/5 gal of water

Note: Engine washes and rinses are conducted based on the number of hours the engines are operated. This cleaning evolution varied in frequency depending on the type of aircraft. All engines were washed using a mixture of gas path (TURCO 5484) MIL-C-85704C, Type I or Type IIA gas turbine cleaner and water followed with freshwater rinses. The amount of gas path cleaner used varied with engine type as listed below. The water and cleaning solutions from both processes drained to the deck and overboard outside 12 nm.

Table 4-2— Estimated Quantities of Discharge per Aircraft for Each Aircraft Washdown

Aircraft Type	Cleaning Compound Solution
F-14	10 gal/aircraft
F/A-18	5 gal/aircraft
AV-8	1.5 gal/ aircraft
S-3	3 gal/ aircraft
EA-6B	4 gal/ aircraft
EC-2	5 gal/ aircraft
SH-60	1.5 gal/ aircraft
UH-1	1 gal/ aircraft
AH-1	1 gal/ aircraft
CH/MH-53	2.25 gal/ aircraft
CH-46	1 gal/ aircraft

Note: The majority of airframe and engine wash evolutions are conducted outside of the contiguous zone. However, residual cleaning compounds may become trapped in the non-skid surfaces of the flight decks and subsequently discharged overboard during a rainfall event in the contiguous zone. Following aircraft departure, all vessels surveyed conducted a total exterior topside surface washdown while outside the contiguous zone. The amount of cleaning compounds used for aircraft and engine washdown that contributes to deck runoff within 12 nm was residual and could not be estimated.

Table 4-3— Potential Discharge Materials for Aircraft Washdown

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Aircraft Cleaning Compound, MIL-C-87937D	Unknown	2-Butoxyethanol	111726	1 - 5	Unknown	None
		Cyclohexanol	108930	1 - 5	Unknown	None
		Aromatic hydrocarbons	64742945	20 - 40	Unknown	Unknown
Aircraft Cleaning Compound, MIL-PRF-85570C, Type II	Unknown	Dipropylene glycol methyl ether	34590948	10	Unknown	None
		Morpholine	110918	0.5	Unknown	None
		Ethoxylated nonylphenol	—	Unknown	Unknown	None
		Alkanolamide	—	Unknown	Unknown	None
Hydraulic Fluid, MIL-PRF-83282D	Unknown	Synthetic hydrocarbon based oil	—	> 65	Unknown	Unknown
		Ester based lubricant	—	< 35	Unknown	Unknown
Lubricating Oil, MIL-PRF-23699F	Unknown	Polyol esters	—	100	Unknown	Unknown
Grease, MIL-PRF-23827C	Unknown	Synthetic ester	—	75 - 85	Unknown	None
		Lithium 12 hydroxystearate	7620771	10 - 15	Unknown	None
		Antimony dialkyldithiocarbamate	15890252	1 - 2	Unknown	None
		p,p'-Dioctyldiphenylamine	101677	1	Unknown	None
Grease, MIL-PRF-81322F	Unknown	Mixture of paraffinic, naphthenic, and aromatic hydrocarbons	—	Unknown	Unknown	None
Gas Path Cleaner, MIL-C-85704C	Unknown	Dipropylene glycol methyl ether	34590948	10	Unknown	None
		Hexylene glycol	107415	10	Unknown	None
		Heavy aromatic naphtha	64742945	Unknown	Unknown	None
		Triethanolamine	102716	Unknown	Unknown	None
		Nonylphenol polyethoxate	9016459	Unknown	Unknown	None

Table 4-4— Narrative Parameters for Aircraft Washdown

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Colloidal Matter	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Unknown-not evaluated
Hardness	Unknown-not evaluated
Nutrients	Unknown-not evaluated
Odor	Unknown-not evaluated
Oil and Grease	None observed, no sheen noted
Pathogens	Unknown-not evaluated
PH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Does not change temperature
Total Dissolved Gases	Unknown-not evaluated
Turbidity	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment. The information is based on assessment survey team recollection and consensus.

4.2 ELECTRONIC INTELLIGENCE/NAVIGATION SYSTEMS MAINTENANCE

Process information on the electronic intelligence/navigational systems was obtained during the AOE 6, DDG 51, MCM 1, WLM 175, and WPB 110 shipboard assessments. Due to the self-contained radar, no maintenance is performed except to determine oil levels and grease levels. Whip, or flexible unstayed antenna maintenance is limited to applying small amounts of silicone to the couplers and applying a sealing compound that hardens in 24 hr. Preservation and painting is limited to touch up painting. With the exception of the MCM 1 Class, electronic intelligence and search/navigational systems do not contribute to deck runoff. The MCM 1 Class vessels clean the surface search and navigation radar rotating assemblies with freshwater and a small amount of a cleaning compound (Simple Green™), which has the potential to contribute to deck runoff.

4.3 EQUIPMENT AND VEHICLE WASHDOWNS

Vessels can carry and transport a variety of different equipment and vehicles. These vehicles can be used as part of the vessel's normal operations (e.g., aircraft towing tractors) or the vehicles can be cargo (e.g., tanks). This equipment is washed frequently to prevent build up of salt from sea spray. The constituents from equipment and vehicle washdowns that contribute to deck runoff include salt residue, dirt, oil, grease, and cleaning compounds. Most Navy and USCG equipment and vehicle washdowns are performed outside 12 nm, however some residue remains trapped in the rough deck surface and may contribute to deck runoff inside 12 nm (Wenzel, 2000e; Wenzel *et al.*, 2001b, 2001c).

A diverse assemblage of U.S. Army vessel classes may carry and transport vehicles on the weather deck. These vessel classes include, but are not to limited to, landing craft (e.g., LCM 8, and LCU 2000), non-powered barges, and logistic support vessels (LSV). Transported vehicles are normally part of the vessel's cargo (e.g., tanks, and humvees). War fighting ground equipment/cargo is always taken to a land-based wash rack for washdowns. Any petroleum product that might fall from the war fighting ground equipment/cargo to the deck is immediately cleaned up. However, residual petroleum products may become trapped in the rough deck surface and have the potential to contribute to deck runoff (Legge, 2002b). The materials that have the potential to contribute to deck runoff include: MIL-PRF-2104G and MIL-PRF-2105E lubricating oil, MIL-G-10924G automotive and artillery grease, MIL-PRF-46170C fire resistant hydraulic fluid, MIL-L-23549 general purpose grease, MIL-G-18458B wire rope grease, and SAE AS8660 silicone compound. The following table lists these compounds and their bulk constituents.

Table 4-5— Potential Discharge Materials for Equipment and Vehicle Washdowns

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Lubricating Oil, MIL-PRF-2104G	Unknown	Petroleum hydrocarbons	—	Unknown	Unknown	Unknown
Lubricating Oil MIL-PRF-2105E	Unknown	Petroleum hydrocarbons	—	Unknown	Unknown	Unknown
Wire Rope Grease, MIL-G-18458B	Unknown					
		Phosphorous (Yellow)	7723140	Unknown	Unknown	None
		Petroleum carriers	—	Unknown	Unknown	Unknown
General Purpose Grease, MIL-G-23549	Unknown	Petroleum hydrocarbons	—	Unknown	Unknown	Unknown
Automotive and Artillery Grease, MIL-G-10924G	Unknown	Petroleum hydrocarbons	—	100	Unknown	Unknown
Fire Resistant Hydraulic Fluid, MIL-PRF-46170C	Unknown	Synthetic hydrocarbon base oils	68649127	60 - 65	Unknown	Unknown
		Synthetic esters	—	25 - 30	Unknown	Unknown
		Barium dinonylnaphthalene sulfonate	25619561	2 - 3	Unknown	None
		Tricresyl phosphate	1330785	1 - 2	Unknown	None
Silicone Compound, SAE AS8660	Unknown	Dimethylpolysiloxane	63394025	90	Unknown	None
		Silica	112945525	10	Unknown	None

4.4 EXTERIOR TOPSIDE SURFACE WASHDOWN

The survey team gathered exterior topside surface washdown information during all vessel assessments. Exterior topside surface washdowns include cleaning all exterior surfaces and maintaining their cleanliness. The washdown effluent may contain dirt, rust, salt, paint chips, hydraulic fluid, fuel, lubricating oil, greases, soot, cleaning compounds, and other materials. The frequency and types of cleaning evolutions vary with vessel class and geographic location (inside/outside 12 nm) but is detailed below.

4.4.1 AOE 6 Class

The survey team observed the crew sweeping the deck throughout the day as part of their daily routine. The decks are swabbed using freshwater and small amounts of general purpose cleaner (MIL-D-16791G). Additionally, the survey team observed the crew swabbing all weather decks immediately after each rain squall using only the rainwater on the weather deck (no cleaning compounds). This practice is indicative of the proactive approach the command takes to ensure the vessel remains clean using all available resources. Due to the small amount of cleaning compound used, the survey team concluded that cleaning does not contribute to deck runoff.

When underway at distances greater than 25 nm from shore, the crew washes the deck once a week with freshwater. When in port, the deck is swept and swabbed only, therefore no effluent is generated. The crew uses corn brooms and scrub brushes to clean the deck with a solution of MIL-D-16791G general purpose detergent and freshwater. Approximately 1.5 gal of the general-purpose detergent is used to clean the entire vessel. The washdown evolution for the entire vessel (except helicopter deck) takes approximately 6 hr with the water running approximately 50 % of the time. The helicopter deck is cleaned with the same detergent/water mixture using a 0.75 in garden hose at 20 psi without a nozzle and requires approximately 25 min. The survey team collected information on this process by interviewing fleet personnel. The amount of time and detergent used when conducting the washdown was provided by crewmembers participating in the vessel washdown. Due to harsh weather conditions, a washdown was not performed while the survey team was on the ship. Therefore, the survey team was unable to observe and document a washdown; exact times and generation rates for washdowns are not known. The survey team observed the crew swabbing the deck immediately after each rainsquall using only the rainwater (no detergent) remaining on the deck surface, thereby cleaning the deck, and reducing the vessel’s freshwater usage. Because scheduled non-rain squall washdowns occur outside 25 nm, the only contaminants entering surrounding waters inside the contiguous zone are residual contaminants that become trapped in the rough deck surface and subsequently discharged overboard within 12 nm (e.g., during a rainfall event) (Wenzel *et al*., 2001a).

Materials used during aircraft maintenance and engine cleaning have the potential to become trapped in the rough deck surface and subsequently contribute to deck runoff within 12 nm. However, because the deck surfaces are typically cleaned outside the 12 nm limit, only residual constituents may be discharged within 12 nm.

4.4.2 CV/CVN 68 Class

Two separate assessments were conducted aboard a CV/CVN 68 Class vessel. The first assessment was conducted after the vessel had been at sea, conducting flight operations for two months. The second assessment was conducted following six months of at-sea flight operations. The objective of the second assessment was to document preparations taken to ensure flight deck cleanliness prior to the vessel entering the contiguous zone at the end of a six-month deployment. During both assessments, the survey team expected to find an accumulation of jet fuel, grease, and oil on the flight deck; however, observations revealed that most of the stains on the deck were tire residue from the thousands of aircraft launch and recovery evolutions with limited staining from fuel, grease, and oil residue.

Flight deck cleanliness is a safety issue. Liquid remaining on the flight deck can be drawn into the aircraft intake and be as damaging to an aircraft as a solid object. The vessel maintains constant and tight control over flight deck cleanliness by providing detailed written instructions and recording cleaning evolutions. These are a part of the air detachment standard operating procedures. The details of the actual execution of the cleaning evolutions may vary from vessel to vessel, but the general nature of the procedures is similar for all vessels in the fleet.

The survey team observed and documented a section of the flight deck being cleaned during the survey team's first night at sea. Survey team members recorded all maintenance actions performed on the area for four days, then visually examined the area to identify potential contaminants. Stains caused by materials leaked onto the deck and absorbed by the non-skid deck surface were visible. During the four-day period, 100 aircraft refueling evolutions, eight aircraft engine washes, and 60 routine maintenance processes (e.g., change tires, service hydraulic system, etc.) were performed on this section of the deck.

Following is a synopsis of observations made during the two at-sea assessments (Wenzel *et al*., 2001a).

<u>First At-Sea Assessment</u>. It was readily evident that the crew was successful in maintaining flight deck cleanliness. The crew used two methods to clean the flight deck: a nightly scrubbing exercise referred to as a "SCRUB-X", and continuous cleaning using a mechanical flight deck scrubber.

- <u>*SCRUB-X*</u>. At the beginning of the deployment, a diagram was developed to divide the flight deck into eight sections. Each embarked air squadron is responsible for one section. The sections are cleaned on a rotational basis. A logbook, that identifies the responsible squadron and records when each section is cleaned, is maintained in Flight Deck Control.

  One section of the flight deck is scrubbed each night after flight operations. During a SCRUB-X, the deck is wetted with seawater supplied by the vessel's firemain (95 psi), via a 2.5 in fire hose. After the deck is wet, approximately 5 gal of B&B 88 cleaning compound (see Table 4-6) is spread onto the deck to be cleaned. Approximately 20 – 30 sailors use push-style brooms with long, stiff bristles to "scrub" the flight deck. The sailors form a line and scrub the deck with the brooms, making 10 – 15 horizontal and 10 – 15 passes perpendicular to the original passes. The deck is sprayed with seawater to remove residual soap. The remaining cleaner/water mixture is suctioned into the flight deck scrubber's recovery tank and discharged overboard. The nightly SCRUB-X requires 1 hr to 1.5 hr to clean a 120 ft by 80 ft section, depending on material accumulation.

Each morning before flight operations begin, squadron personnel use pneumatic vacuums to remove liquids and other foreign objects from the aircraft tie-down fixtures located in their assigned section of the flight deck. When this task has been completed, the date, time, and responsible individual are recorded in the logbook.

- *Mechanical Flight Deck Scrubber*. A flight deck scrubber equipped with a vacuum system that recovers residual solution is used to clean the flight deck and remove standing water. The scrubber is a one-person rider type and is equipped with a portable vacuum wand that is used to clean areas inaccessible to the scrubber, two hydraulically powered scrub brushes, a 140 gal solution tank, and a 120 gal recovery tank. The crew creates a cleaning solution by mixing 0.5 gal of a cleaning compound (Simple Green™) and 140 gal of water. The scrubber applies the cleaning solution in front of dual high-speed opposed rotation brushes. The brushes scrub the soiled area and sweep-up debris. The dirty water and debris is contained by the rear vacuum squeegee and suctioned into the recovery tank. The recovered cleaner/water mixture is poured overboard. The survey team noted that the flight deck scrubber was used daily during and between scheduled flight operations to maintain a high level of cleanliness.

Second At-Sea Assessment. A second assessment was conducted at the end of a six-month deployment to observe and document a SCRUB-X of the entire flight and hangar decks. The SCRUB-X was conducted after the air wing disembarked and the vessel was 200 nm from land. Because the vessel had launched and recovered more than 10,000 aircraft during its deployment, there was a significant accumulation of tire residue, but not hazardous constituents.

- *Flight Deck SCRUB-X*. The entire flight deck was cleaned with B&B 88 flight deck cleaner using seawater supplied by the vessel's firemain at 95 gpm through a 2.5 in fire hose. The cleaner was applied to the flight deck from a 55 gal drum using a foaming nozzle. Approximately 40 scrubbers made numerous horizontal passes followed by numerous passes perpendicular to the original passes over each section of the deck. Following the scrubbing, the deck was sprayed with seawater to remove residual soap and tire residue. The cleaner/water/debris mixture flowed directly overboard. Ten drums of cleaner were used to wash the entire flight deck. The survey team observed that the hoses were in use for approximately 23 min to clean a 31,000 ft^2 (approximate) section of the flight deck, resulting in the use of approximately 2,185 gal of water. This section represents 15 % of the entire flight deck area.

- *Hangar Deck SCRUB-X*. The hangar deck (the deck where the aircraft are stored and aircraft maintenance is performed) SCRUB-X also occurred approximately 200 nm from land immediately after the air wing disembarked. A 55 gal drum of B&B 88 cleaning compound was placed on a forklift, punctured, and the forklift was driven around the hangar bay to disperse the contents. Concurrently, freshwater, supplied at 95 gpm through a 1.5 in fire hose, was sprayed on the deck. Approximately 25 sailors used push-style brooms with long, stiff bristles as scrubbing devices and made several horizontal passes followed by numerous passes perpendicular to the original passes over sections of the deck prior to spraying the deck with freshwater to remove residual soap and constituents. The cleaner/water/constituent mixture flowed directly overboard. Six 55 gal drums of cleaning compound were used to clean the hangar deck.

Flight and hangar deck scrubbing exercises occur well beyond (> 200 nm) the contiguous zone. Nonetheless, residual cleaner and constituents may dry on the deck surface or become trapped in the non-skid material and subsequently contribute to deck runoff within 12 nm.

Fixed wing and rotary wing aircraft maintenance materials that have become trapped in the rough deck surface (including MIL-PRF-83282D aircraft hydraulic fluid; MIL-PRF-81322F aircraft grease; and MIL-C-85704C gas path cleaner) have the potential to subsequently contribute to deck runoff within the contiguous zone. However, the deck surfaces are cleaned outside 12 nm; therefore only residual constituents are expected to contribute to the discharge within 12 nm.

4.4.3 DDG 51 Class

An assessment was conducted on a DDG 51 Class vessel when the vessel was pierside. Because the vessel was pierside, the decks were swabbed using mops and a small amount of freshwater (no detergent); care was taken to prevent the water from flowing overboard. During the assessment, all dirt and debris were swept and containerized. It is important to note that when a vessel is in port, the weather deck is normally swept several times a day. As a result of the crew's attention to cleanliness, the potential for topside debris to enter surrounding waters while the ship is in port is minimized.

The deck is washed weekly when the vessel is underway. When underway, the washdown occurs beyond 12 nm of shore and requires approximately 2 hr to clean all weather deck surfaces. A solution of approximately 1 pt of MIL-D-16791G general-purpose detergent is mixed with freshwater supplied by the vessel's 50 psi to 70 psi freshwater system. The washdown process begins with wetting the deck with a 0.5 in garden hose (without an on/off nozzle). The water/detergent solution is lightly dispersed on the deck, and the deck is scrubbed with brooms and brushes. Upon completion of the scrubbing evolution, the garden hose is used to rinse the water/detergent/constituent mixture from the deck. Because detergents are not used when the vessel is in port and the deck is swept several times a day, only minimal amounts of residual soap and debris have the potential to contribute to deck runoff as a result of exterior topside surface washdowns within 12 nm (Wenzel, 2000b).

4.4.4 LHD 1 Class

Although the shipboard assessment was conducted while the vessel was underway, a flight deck washdown was not conducted while the survey team was aboard the LHD 1 Class vessel; however, the crew was interviewed and the process discussed. The crew indicated that the flight deck is cleaned via two methods: a scrubbing exercise (SCRUB-X) and a mechanical flight deck scrubber (Wenzel *et al.*, 2001a).

SCRUB-X. During a SCRUB-X, a cleaning compound is spread onto the flight deck after it has been wetted with seawater supplied from the vessel's firemain. Approximately 20 –

30 sailors use push-style brooms with long, stiff bristles to “scrub” the flight deck. The sailors form a line and scrub the deck with the brooms, making 10 – 15 horizontal passes followed by 10 – 15 passes perpendicular to the original passes. The deck is sprayed with seawater to remove residual soap. The remaining cleaner/water mixture is suctioned into the flight deck scrubber’s recovery tank and poured overboard. The procedure is the same for a hangar deck SCRUB-X except freshwater is used.

The LHD 1 Class vessel had been at-sea for three months and had conducted two flight deck scrubbing exercises concurrent with scheduled testing of the firemain system. Each SCRUB-X lasted 6 hr to 8 hr, with the water from the vessel’s firemain in use 50 % of the time. Visual observations made during the assessment revealed that the flight deck remained stained with tire, grease, and oil residue.

Flight Deck Scrubber. All LHD 1 Class vessels are equipped with a mechanical flight deck scrubber. The flight deck scrubber is a one-person rider type and has a vacuum system that provides suction for residual solution recovery, a portable vacuum wand that is used to clean areas inaccessible to the scrubber, two hydraulically powered scrub brushes, a solution tank, and a recovery tank. The scrubber applies the cleaning solution in front of dual high-speed opposed-rotation brushes. The brushes scrub the soiled area and sweep-up debris. The dirty water and debris are contained by a rear vacuum squeegee and suctioned into the recovery tank. The recovered cleaner/water mixture is discharged overboard.

The LHD 1 assessment provided survey team members the opportunity to compare the LHD flight deck conditions and best management practices to those observed and documented aboard the CV/CVN 68 Class carrier. The LHD 1 Class had 5 fixed and 24 rotary wing aircraft with a moderate operating tempo. The CV/CVN 68 Class had 62 fixed and 7 rotary wing aircraft with a busy operating tempo. Although the CV/CVN 68 Class had far more aircraft and a heavier operating schedule than the LHD 1 Class, the CV/CVN 68 Class vessel decks were significantly cleaner. To achieve and maintain flight deck cleanliness, the CV/CVN 68 Class crew manually scrubbed a section of the flight deck daily. In addition, a mechanical flight deck scrubber was continuously in use onboard the CV/CVN 68 Class vessel both during and after air operations. The survey team was onboard the LHD for six days and did not observe the flight deck scrubber in use, nor was the flight deck manually scrubbed (Wenzel *et al*., 2001a).

LHD 1 Class flight deck personnel stated that it is routine practice for all air capable vessels to conduct a thorough SCRUB-X of the flight and hangar decks using B&B 88 flight deck cleaner at the end of a deployment and prior to entering the contiguous zone. Although flight and hangar deck scrubbing exercises occur outside the contiguous zone only, residual cleaner may dry on the deck surface or become trapped in the non-skid material and subsequently contribute to deck runoff discharge within 12 nm (Wenzel *et al*., 2001a).

Materials used during fixed and rotary wing aircraft maintenance and engine cleaning (MIL-PRF-83282D aircraft hydraulic fluid and MIL-C-85704C gas path cleaner) have the potential to become trapped in the rough deck surface and subsequently contribute to deck runoff discharge within the contiguous zone. However, the deck surfaces are cleaned outside the 12 nm limit and therefore there would only be residual constituents in the discharge within 12 nm.

4.4.5 MCM 1 Class

The weather decks of both MCM 1 Class vessels assessed by the survey team were remarkably clean. As a result of all the mine sweeping and handling equipment being located topside, the deck surface area that is washed is significantly smaller than other war vessels in the same platform category. The frequency of exterior topside surface washdowns is dependent upon the amount of saltwater accumulation. Washdowns are normally conducted once every three weeks. Approximately 60 % of washdowns are conducted pierside, 20 % within the 0 – 3 nm range and 20 % within the 3 – 12 nm range. The crew described two types of washdown evolutions: rinses and full washdowns. Rinses are conducted using a 0.5 in garden hose with a water pressure of 35 psi to 60 psi; the nozzle is normally left open so the water runs continually. No cleaning compound is used during a rinse. Full washdowns are conducted using approximately 2 gal of cleaning compound (Simple Green™). The crew prefers to conduct full washdowns while the vessel is in port receiving pierside services. The full washdown evolution takes approximately 2.5 hr using a 0.5 in garden hose with a water pressure of 35 psi to 60 psi; the nozzle is normally left open so the water runs continuously. If a full washdown is conducted when underway, the water pressure is 55 psi to 65 psi and an on/off nozzle is used to conserve the vessel's freshwater supply. The crew scrubs the deck with corn brooms, scrub brushes, and detergent during a full washdown evolution (Wenzel, 2000c).

4.4.6 U.S. Army Vessels

Onboard U.S. Army vessels, exterior topside surface washdowns are conducted after completion of transportation operations (i.e., embarking/disembarking ground equipment/cargo). The frequency of such practices are dependent on the operational scenario (i.e., ship is carrying war fighting ground equipment/cargo), but are always performed if the ship has taken green water (ocean water that washes over the decks in heavy seas) over the deck. It is common practice for a ship to conduct freshwater washdowns of the topside area prior to entering port. Almost all exterior topside surface washdowns occur inside 12 nm. Any petroleum product that falls from the war fighting ground equipment/cargo to the deck is immediately cleaned up. However, residual petroleum products may become trapped in the rough deck surface and have the potential to contribute to deck runoff. Whereas exterior topside surface washdowns almost always occur inside 12 nm, war fighting ground equipment/cargo is always taken off the ship to a land-based wash rack for washdown (Legge, 2002a).

4.4.7 WLM 175 Class

The crew reported that small amounts (less than 1 quart per month) of cleaning compound (Simple Green™) are used when performing cleaning. During the shipboard assessment, the entire crew focused on buoy maintenance and retrieval, hence no exterior topside surface washdowns were observed. Although only small amounts of cleaning compound (Simple Green™) are used, it is the primary constituent, that has the potential to contribute to deck runoff.

The buoy deck is rinsed after each buoy maintenance evolution to remove the residual marine growth. At the completion of each workday and prior to entering port, the buoy deck is thoroughly washed down using seawater supplied by the vessel's firemain. In accordance with local policy, no detergents were used on the vessels surveyed. The deck is washed using a 3,000 psi pressure washer and fire hoses; the wash-down evolution takes approximately 45 min. Freshwater washdowns are performed infrequently, only in port, and use pier-supplied freshwater (no detergents) (Wenzel, 2000a). However, while the survey team did not report the use of cleaning compounds aboard the surveyed vessel, further research indicated this is not representative of the WLM 175 Class. As a general practice, a top to bottom washdown is conducted at intervals no greater than once per week, provided the ship has been underway. An estimated 5 gal of Simple Green™ is used per vessel per washdown. (Keel, 2001).

On these vessels, daily exterior topside surface washdowns do not contribute to deck runoff. The only materials that enter the surrounding water is marine growth, which is returned to the same "ecological area".

4.4.8 WAGB, WHEC, WMEC, WLI, WLIC, WLR, WTGB, WYTL, and WLB Classes

For the WAGB, WHEC, and WMEC Class vessels, complete topside washdowns are conducted following every patrol and are typically done in port. However, these washdowns may be commenced while at sea the day or night prior to mooring depending on weather conditions and availability of freshwater. During complete washdowns, approximately 5 gal of cleaning compound (Simple Green™) is used per vessel. These vessels make 2 to 6 patrols per year. Spot cleaning of deck surfaces is also conducted, as needed, while in port. It was estimated that during spot cleanings, 1 gal of cleaning compound (Simple Green™) is used per wash. Freshwater washdowns without soap are also conducted periodically throughout the time in port (Keel, 2001). For the WLI, WLIC, WLR, WTGB, and WYTL Class vessels, a freshwater washdown is conducted, at a minimum, upon their return to port. These vessels are in and out of port daily. Washdowns using cleaning compound (Simple Green™) are conducted approximately once per week using an estimated 1 gal of Simple Green™ (Keel, 2001). For the WLB Class vessels, washdowns are conducted approximately once per week provided the vessel has been underway. During washdowns, approximately 5 gal of cleaning compound (Simple Green™) is used per vessel (Keel, 2001). The primary constituent resulting from cleaning these vessels is the cleaning compound (Simple Green™).

4.4.9 WPB 110 , WPB 87, and Vessels 55 Ft and Under

The survey team conducted three pierside assessments of WPB 110 Class vessels at two homeports. During all assessments, dirt and debris were swept, containerized, and turned in to the homeport's Hazardous Materials Minimization Center. Because the overboard discharge of detergents at the first homeport surveyed is prohibited, the crew swabs their decks using a mop dampened with freshwater and a very small amount of cleaning compound (Simple Green™). The crew ensures excess water containing the detergent does not drain overboard in port. The primary constituent resulting from cleaning is a small amount of cleaning compound (Simple Green™). However, while the surveyed patrol boat reported very limited use of detergents, further research indicated this is not representative of the WPB and Under 55 ft Classes. For the WPB 110 and WPB 87 Classes, the general practice is a top to bottom wash with a solution of cleaning compound in freshwater upon return to port (approximately 3 to 4 times per month). During washdowns, approximately 2 gal of cleaning compound (Simple Green™) is used per vessel (Keel, 2001). These patrol boats are also frequently spot cleaned on the aft freeboard because that area is heavily blackened by the exhaust soot. The general rule for vessels under 55 ft is a freshwater washdown, at a minimum upon returning to port; these vessels are in and out daily. Washdowns using cleaning compound solutions occur at intervals no greater than once daily. During washdowns, approximately 0.5 gal of cleaning compound (Simple Green™) is used per vessel. The washwater drains directly overboard. There are also reports that the fleet uses approximately 2 oz to 6 oz of Zip Wax™ Car Wash per washdown (Keel, 2001).

Due to the unique mission of WPB Class vessels, they are sometimes required to hold and transport migrants on the weather deck of the vessel. The migrants remain on the weather deck and do not enter the hull of the vessel. During these missions, other materials such as human waste, fibers from blankets and clothes, as well as human hair and food particles contribute to deck runoff. A portable toilet is placed on a shrouded area of the weather deck and remains topside until the migrants disembark. The portable toilet is not piped to the vessel's plumbing. The crew is required to drain the toilet overboard and hose down the area. During this process, or when migrants choose not to use the toilet facilities, human waste residue may remain trapped in the rough deck surface and contribute to deck runoff inside 12 nm.. These vessels frequently carry as many as 30 – 50 migrants for a period of several days. The time the migrants are aboard the vessel is dependent upon several factors (e.g., how far away the vessel is from a larger receiving vessel the vessel is, how long it takes to resolve legal issues, and how long it will take the vessel to transit if they are required to return the migrants to their homeland). The migrants are housed on the aft section of the weather deck and only moved forward during exterior topside surface washdowns. The crew reported that fibers from blankets and clothes, as well as human hair and food particles, litter the deck and are washed overboard; this most frequently (85 %) occurs outside 12 nm. The crew indicated that most deck runoff occurs during exterior topside surface washdowns conducted after alien migration interdiction operations (Wenzel *et al*., 2001a).

The vessels at each homeport conducted exterior topside surface washdown operations differently. The exterior topside surface washdown processes for the two homeports visited are described below (Wenzel *et al*., 2001a).

> Homeport A: When pierside, the crew uses freshwater supplied from pierside services to rinse the vessel twice weekly. This rinsing process takes 2 hr using a 0.75-inch garden hose at a pressure of 40 psi to 50 psi, normally without an on/off nozzle attached. No detergents are used when pierside. When underway, washdowns are conducted prior to entering port, approximately 17 times per month. The crew estimated 75 % of underway washdowns are conducted within the contiguous zone. The crew uses freshwater and approximately 0.5 gal of cleaning compound (0.5 gal of Simple Green™ and 2 oz to 3 oz of Brite Creme™) on the hull. The washdown process takes 8 hr (depending on how dirty the deck is) using freshwater and a garden hose equipped with an on/off nozzle. The crew estimated that the water is on for approximately 3 hr of the 8 hr.

> Homeport B: When pierside, weekly washdowns are conducted using freshwater and 0.5 gal of cleaning compound (Simple Green™). This process takes approximately 4 hr using a 0.75 in garden hose with a water pressure of 50 psi to 70 psi and an on/off nozzle attached. When underway, the crew uses only salt water supplied from the vessels 160 psi

firemain. Depending on how dirty the deck is, this process takes approximately 2 hr to 3 hr.

4.4.10 Cleaning Compounds

During the shipboard assessments, the survey team observed the crews performing cleaning throughout the day. On almost every vessel visited, the survey team noted very clean weather decks with no visible paint chips, dirt, or debris and attributed this to good housekeeping. As a result of the survey team's observations, cleaning should be considered a marine pollution control device (MPCD) to control paint debris from entering surrounding waters (Wenzel *et al*., 2001a). Constituents resulting from painting activities are addressed in more detail in the exterior topside surface preservation section.

<u>*Sweeping*</u> As part of the vessel crews' daily routine, it is common practice to sweep all decks at least twice daily and immediately following all paint removal evolutions. Immediately after sweeping, all debris is containerized and removed from the area. If visible debris remains on the deck, the area is vacuumed. All debris containing paint chips is turned in to the HAZMINCEN (hazardous materials minimization center) for disposal ashore.

<u>*Swabbing*</u> Also as part of the vessel's daily routine, it is common practice to damp-swab topside decks. This process uses small quantities of water that does not run overboard. In fact, swabbing the decks enhances the removal of residual paint debris.

<u>*Trash Removal.*</u> All debris containing paint chips is turned in to the shipboard HAZMINCEN for disposal ashore.

The following information was obtained during the AOE 6, DDG 51, MCM 1, WLM 175 and WPB 110 Class shipboard assessments**.** The exterior topside surface washdown process varies from vessel to vessel. Vessels that operate on the high seas generally wash decks while underway and outside the contiguous zone. Vessels operating within the contiguous zone often wash down decks while in port. Exterior topside surface washdown practices are listed in the following table.

Table 4-6— Exterior Topside Surface Washdown Practices

Vessel Class	Cleaning Compound	Cleaning Compound Amount	Washdown Conducted Inside/Outside Contiguous Zone	Water Used	Frequency
AOE 6	MIL-D-16791G	1.5 gal	Outside	Freshwater	Weekly
CV/CVN 68	B&B 88	550 gal	Outside	Saltwater	Prior to entering contiguous zone
DDG 51	MIL-D-16791G	1 gal	Outside	Freshwater	Weekly
LHD 1	B&B 88	Unknown	Outside	Saltwater	Prior to entering contiguous zone
MCM 1	Simple Green™	2 gal	Inside	Freshwater	3 week cycle
WAGB	Simple Green™	5 gal	Inside	Freshwater	2-6 times/yr
WLI	Simple Green™	1 gal	Inside	Freshwater	Weekly
WLB	Simple Green™	5 gal	Inside	Freshwater	Weekly
WLM 175	Simple Green™	5 gal	Inside	Fresh/Salt*	Weekly
WPB 110	Simple Green™ Brite Creme	2 gal 2 oz to 3 oz	Inside Inside	Freshwater Freshwater	Weekly Weekly
≤ 55 ft	Simple Green™ Zip Wax Car Wash™	0.5 gal 2 oz to 6 oz	Inside Inside	Freshwater Freshwater	Daily Daily

*WLM used salt water when underway and freshwater when in port.
*WAGB Class also includes: WHEC, WMEC
*WLI Class also includes: WLIC, WLR, WTGB, and WYTL
*WPB 110 Class also includes: WPB 87

Vessels that perform exterior topside surface washdowns outside the contiguous zone may have residual amounts of cleaning compounds trapped in the rough deck surfaces. While the amount of cleaning compounds is unknown, it could contribute to deck runoff within 12 nm. Cleaners used in port during exterior topside surface washdowns contribute to deck runoff. Human waste and debris may also be contributors to deck runoff onboard the WPB Class vessels (see section 4.4.9).

Example calculations for discharges inside 12 nm are as follows:

<u>MCM 1</u>. MCM 1 Class vessels are categorized as mine warfare vessels. There are 14 MCM 1 Class vessels. All assumptions are based on information gathered onboard the MCM Class vessels surveyed. Assuming 60 % of the year (i.e., 31 weeks) is spent operating within 12 nm or in port, the following applies:

31wks x 1 washdown every 3 weeks ≈ 10 washdowns x 2 gal of cleaning compound (Simple Green™) per washdown = 20 gal/vessel·yr.

20 gal/vessel·yr x 14 vessels= 280 gal of cleaning compound (Simple Green™).

<u>WLM 175 (USCG)</u>. WLM 175 Class vessels are categorized as tenders; there are 83 vessels in this class. All assumptions are based on information gathered onboard the WLM 175 Class

vessels surveyed. WLM Class vessels use a cleaning compound (Simple Green™) for exterior topside surface washdown.

<u>WPB 110 (USCG)</u>. WPB 110 Class patrol vessels are categorized as cutters. There are 96 smaller cutters that operate as patrol craft vessels. These patrol cutters do not necessarily provide an accurate representation of the vessels in the small boats and craft category. All assumptions are based on information gathered onboard the WPB Class vessels surveyed. Assuming 90 % of the year (i.e., 47 weeks) is spent operating within 12 nm or in port, the following applies:

47 wks x 2 gal cleaning compound (Simple Green™)= 94 gal/vessel·yr.
94 gal/vessel·yr x 96 vessels= 9024 gal of cleaning compound (Simple Green™)

47 wks x 0.02 gallon cleaning compound (Brite Creme™)= 0.94 gallon/vessel·yr.
0.94 gallon/vessel·yr x 96 vessels= 90 gal of cleaning compound (Brite Creme™)

Table 4-7— Potential Discharge Materials for Exterior Topside Surface Washdowns

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Cleaning Compound (Simple Green™)	2.0E+05 (estimated)	2-Butoxyethanol	111762	< 6	< 1.2E+04	None
Cleaning Compound (Brite Creme™)	9.0E+01 (estimated)	Unknown	—	Unknown	Unknown	Unknown
Cleaning Compound (Zip Wax Car Wash™)	1.5E+04 (estimated)	Unknown	—	Unknown	Unknown	Unknown
Flight Deck Cleaner (B&B 88)	Negligible	Unknown	—	Unknown	Negligible	Unknown
Degreaser, MIL-D-16791G	Negligible	Unknown	—	Unknown	Negligible	Unknown
Hydraulic Fluid, MIL-PRF-83282D	Negligible	Synthetic hydrocarbon based oil Ester based lubricant	— —	> 65 < 35	Negligible Negligible	Unknown Unknown
Grease, MIL-PRF-81322F	Negligible	Mixture of paraffinic, naphthenic and aromatic hydrocarbons	—	Unknown	Negligible	Unknown
Gas Path Cleaner, MIL-C-85704C	Negligible	Dipropylene glycol methyl ether	34590948	10	Unknown	Unknown
		Hexylene glycol	107415	10	Unknown	Unknown
		Heavy aromatic naphtha	64742945	Unknown	Unknown	Unknown
		Triethanolamine	102716	Unknown	Unknown	Unknown
		Nonylphenol polyethoxate	9016459	Unknown	Unknown	Unknown
Human Waste/Debris	Unknown	Unknown	—	Unknown	Unknown	Unknown
Jet Exhaust Soot	Unknown	Unknown	—	Unknown	Unknown	Unknown

*Note: A full analysis was not conducted on jet exhaust soot, but may contain carbonaceous material, sulfates, and by-products of incomplete combustion of JP-5.

Table 4-8—Narrative Parameters for Exterior Topside Surface Washdowns

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential Exists
Hardness	Potential Exists
Nutrients	Unknown-not evaluated
Odor	Potential Exists-did not evaluate
Oil and Grease	None observed, no sheen noted
Pathogens	Potential Exists-not qualified to evaluate
PH	Unknown-not evaluated
Settleable Materials	Potential Exists
Specific Conductance	Unknown-not evaluated
Suspended Solids	Potential Exists
Taste	Unknown-not evaluated
Temperature	Does not change temperature
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment. The information is based on survey team recollection and consensus.

4.5 FIREMAIN SYSTEMS

Contaminants that may or may not result from using firemain systems are being addressed as a separate UNDS discharge. The survey team was tasked to determine if the firemain system contributes to deck runoff. The firemain system on all vessels surveyed used saltwater supplied at various pressures, depending on vessel class. Saltwater from this system is also used during the exterior topside surface washdown evolution on some vessels. Therefore, water from the firemain is a component of deck runoff. However, the constituents from the firemain itself will be evaluated as its own discharge.

4.6 PERFORMANCE OBJECTIVE AND ACTIVITIES

The objective for cleaning activities/general housekeeping is for the vessel's responsible party to prevent the discharge of cleaning compounds, hydraulic fluids, oils, fuels, greases, dirt, salts, soot, and other materials associated with cleaning activities/general housekeeping that may negatively impact water quality. Activities that could be performed to meet this performance objective include, but are not limited to: minimizing cleaning for aircraft, exterior topside surfaces (ETS), equipment, and vehicles within 12 nm; using a vacuum to remove water from aircraft washdowns conducted outside 12 nm; using a flight deck scrubber; and cleaning deck tie down fixtures with vacuums.

Fixed and rotary wing aircraft are washed both inside and outside 12 nm, depending on the patrol areas of the vessels to which they are assigned. When the patrol for aircraft capable vessels occurs beyond 12 nm, the aircraft are generally washed outside 12 nm. For example, fixed wing aircraft, found only on Navy vessels, are always washed outside 12 nm. Rotary wing aircraft can be washed inside or outside 12 nm. On Navy vessels, rotary wing aircraft operations occur outside 12 nm. These aircraft are washed outside 12 nm. On USCG vessels, rotary wing aircraft may be washed inside or outside 12 nm, with the majority of aircraft washes occurring outside 12 nm. If the aircraft were washed outside 12 nm, the washwater, grease, detergents, and other constituents flowing overboard would not be regulated by UNDS and only the residue that becomes trapped in the rough deck surface has the potential to contribute to deck runoff inside 12 nm.

Exterior topside surface (ETS) washdowns are conducted both inside and outside 12 nm, depending on the patrol area of the vessel. If ETSs were washed outside 12 nm, the mass loadings of constituents present on the deck that contribute to deck runoff inside 12 nm would be reduced. Vessels perform ETS washdowns regardless of their location when conditions or requirements necessitate a washdown. For this activity, vessels would not specifically transit outside 12 nm to conduct ETS washdowns (Navy, 2001).

Conducting equipment and vehicle washdowns outside 12 nm would reduce constituents, such as grease and oil, from the deck that could contribute to deck runoff within 12 nm. Crews perform equipment and vehicle washdowns, regardless of their vessel's location, when washdowns are necessary based on conditions or requirements. For this activity, vessels would not specifically transit outside 12 nm to conduct equipment and vehicle washdowns. One method the U.S. Army uses to minimize washdowns inside 12 nm, is conducting equipment and vehicle washdowns on a land-based wash rack. The equipment is removed from the vessels and washed on a rack, where all the constituents are collected for proper disposal. Minimizing cleaning for equipment and vehicles is currently in place for the ground support equipment and vehicle transport processes (Navy, 2001).

During aircraft washdowns outside 12 nm, a wet/dry vacuum may be used to remove the washwater generated. A crewmember would use the vacuum to contain and recover the cleaning compound/water mixture before it becomes trapped in the rough deck surface where it could later contribute to deck runoff. No tanks are currently available to hold this washwater. Therefore, the washwater would be discharged overboard outside 12 nm. This activity does not present an environmental benefit for washdowns conducted inside 12 nm, because the washwater is discharged overboard. For vessels operating outside 12 nm, the constituents of deck runoff (e.g., dirt, oil, and grease) are removed from the deck before the vessel transits within 12 nm. Small aircraft-capable vessels (e.g., WMEC) that only carry one or two rotary wing aircraft have small flight decks. On these vessels, the aircraft washwater that is not trapped in the rough deck surface immediately runs to, or can be washed down, a deck drain that discharges directly overboard.

A flight deck scrubber is a ground washer that uses cleaning compounds, water, and rigid brush bristles to clean the flight deck. On the CV/CVN and LHD 1 Class vessels, a Tennant 550 Riding Power Scrubber is used to remove oil, grease, dirt, and other debris found on the flight deck. No tanks are currently available to hold this washwater. As a result, the washwater is discharged overboard, outside 12 nm. For smaller, air-capable vessels, such as the DDG 51 and AOE 6 Class vessels, smaller, walk-behind scrubbers are available. Operators walk behind these scrubbers; the scrubbers temporarily collect the water and debris in a holding tank. Using flight deck scrubbers reduces the amount of constituents that may become trapped in the rough deck surface and subsequently contribute to deck runoff when the vessel transits within 12 nm. For vessels operating outside 12 nm, many of the constituents of deck runoff are removed or their contribution reduced, from the deck before the vessel transits within 12 nm. The rider scrubbers are currently used on all large flight deck vessels such as CV/CVN and LHD 1 Class vessels. Some smaller, air-capable vessels use walk-behind scrubbers. Small aircraft capable vessels only carry one or two small rotary wing aircraft. Washwater produced by manual scrubbing methods immediately runs to, or can be washed down, deck drains that discharge directly overboard. Therefore, flight deck scrubbers may not be practical for small aircraft capable vessels. The residuals of constituents trapped in the rough deck surface could subsequently contribute to deck runoff inside 12 nm.

The last activity is using a pneumatic wet/dry vacuum cleaner, or other effective means, to remove liquids and other debris out of recessed tie down fixtures. A recessed tie down fixture is used as a fastening point for straps and chains to secure aircraft and other equipment on a vessel's deck. The debris and constituents collected in the vacuums are containerized and discharged overboard outside 12 nm on Navy vessels. Cleaning the liquid and debris from the recessed tie down fixtures reduces the potential for these constituents to wash off the deck when the vessel is within 12 nm. USCG vessels operate both inside and outside 12 nm, therefore, cleaning the recessed tie down fixtures could occur inside or outside 12 nm. Performing this activity inside 12 nm is expected to produce a localized environmental benefit because the liquid and debris do not contribute to deck runoff while the vessel is in port.

5.0 DECK MACHINERY AND WEAPONS LUBRICATION

Deck machinery and weapons lubrication includes aircraft elevators, buoy handling systems, fire assist vehicles, mine handling systems, recovery, assist, securing, and traversing (RAST) systems, ship's boats launching systems, stores handling systems, towing and mooring systems, and weapons systems. The aircraft elevators were assessed on CV/CVN 68 and LHD 1 Class vessels. Grease was found to contribute, in small amounts, to the deck runoff both inside and outside 12 nm for both classes of vessel. The buoy handling system was assessed on USCG buoy maintenance vessels (Wenzel *et al*., 2001a).

These vessels mainly work within 12 nm cleaning, inspecting, repairing, and preserving buoys. Grease and hydraulic fluid can be trapped within rough deck surfaces and contribute to the deck runoff within 12 nm by these vessels. The survey team determined that fire assist vehicles do not contribute to deck runoff (see Section 5.3). Mine handling systems were found to have the potential to contribute lubricating oil to deck runoff through residuals being trapped in rough deck surfaces. The RAST system has the potential to contribute to deck runoff within 12 nm when grease applied to traverse cables migrates to non-skid surfaces and becomes entrained in washwater, rainwater, green water, etc. Stores handling systems were evaluated on the AOE 6 and DDG 51 Class vessels only. For both vessel classes, residual amounts of general purpose cleaner and grease have the potential to contribute to deck runoff due to rainfall or heavy seas within 12 nm. The survey team determined that towing and mooring systems do not contribute to deck runoff (see Section 5.8). Finally, the weapons systems aboard the AOE 6, DDG 51, MCM 1 and WPB 110 Class vessels were evaluated. All weapon systems were found not to contribute to deck runoff with the exception of the 5"/ 54-caliber lightweight gun mount and Close-In Weapon System (CIWS). These gun mounts and close-in weapons systems are maintained using a cleaner/lubricant/ preservative that can contribute to deck runoff within 12 nm when the vessels are operating during heavy seas or rainfall. It is important to note that, depending on operating conditions (hot, cold, humid, or dry), the amount of grease that could contribute to deck runoff may vary greatly. As with any grease or lubricant that is exposed to the elements, changing weather conditions (especially high temperature) could affect the viscosity of the grease, and, therefore, the amount of grease that may fall to the deck (Wenzel *et al*., 2001a).

5.1 AIRCRAFT ELEVATORS

Aircraft elevators are used to move aircraft from the hangar deck to the flight deck. Elevator cables, rails, and stanchions are lubricated by hand using DOD-G-24508A, MIL-G-23549, MIL-G-18458B, and MIL-G-24139A grease (see Table 5-1) (Navy, 2000). These elevator components are partially exposed to the weather, so rain and wind may cause these lubricants to fall to the deck or water, contributing to deck runoff both inside and outside 12 nm.

5.1.1 CV/CVN 68 Class Petroleum, Oil, and Lubricants

For the CV/CVN 68 Class, four aircraft elevators transport aircraft between the hangar and flight deck levels. Each aircraft elevator is 4,000 ft^2 and is capable of transporting up to 3 aircraft at one time. All safety stanchions, locks, and cables are cleaned and lubricated by hand using MIL-G-23549, MIL-G-24139A, and MIL-G-18458B greases. The amount used depends upon the maintenance action performed and the person performing the maintenance. Information gathered from the crew revealed an average usage of 2 gal to 5 gal of grease per elevator. The largest contributor to deck runoff resulting from the operation and maintenance of aircraft elevators is MIL-G-23549 grease used to lubricate the elevator's operating cables. Although 4 gal of grease are used to lubricate each elevator, only a small amount has the potential to wash off within 12 nm because it is partially sheltered by the vessel structure (Surgeon, 2001; Wenzel *et al*., 2001a).

5.1.2 LHD 1 Class Petroleum, Oil, and Lubricants

For the LHD 1 Class, two aircraft elevators transport aircraft between the hangar and flight deck levels. Elevator cables, safety stanchions, and rails are lubricated using MIL-G-23549, DOD-G-24508A, and MIL-G-18458B greases. As with the CV/CVN Class vessel, the amount of material used varies with the maintenance action performed, and the person performing the maintenance. However, information gathered from the crew revealed that an average of 2 gal to 5 gal of grease is applied quarterly to each elevator. Only a small amount has the potential to wash off within 12 nm during heavy seas or a rainfall event and contribute to deck runoff because the largest portion of cable is housed on the elevator engine that is internal to the ship (Surgeon, 2001, 2002;Wenzel *et al*., 2001a).

Information regarding the potential discharge materials for aircraft elevators is presented in the following table.

Table 5-1— Potential Discharge Materials for Aircraft Elevators

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
General Purpose Grease, MIL-G-23549	1.7E+03	Petroleum Hydrocarbons	—	Unknown	Unknown	Unknown
Multipurpose Grease, MIL-G-24139A	9.6E+01	Petroleum Hydrocarbons	—	Unknown	Unknown	Unknown
Wire Rope Grease, MIL-G-18458B	1.4E+02	Phosphorous (yellow)	7723140	Unknown	Unknown	None
		Petroleum carriers	—	Unknown	Unknown	Unknown
Grease, DOD-G-24508A	Unknown	Synthetic hydrocarbon	—	> 73	Unknown	Unknown
		Sodium nitrite	7632000	< 1.5	Unknown	None

Table 5-2—Narrative Parameters for Aircraft Elevators

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists
Hardness	None
Nutrients	None
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
Pathogens	None
PH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment. The information is based on survey team recollection and consensus.

5.2 BUOY HANDLING SYSTEMS

Buoy handling systems are found on USCG vessels that conduct buoy maintenance. Buoy maintenance includes cleaning, inspection, repairing and preservation. Buoys that are used for navigational and weather observation purposes are maintained both within and beyond 12 nm, with the majority of buoys inside 12 nm. Buoys, along with their sinkers and anchor chains, are raised from their position in the water and hauled on deck using cranes and cross-deck winches. The wire rope on the cranes and cross-deck winches is lubricated with MIL-G-18458B grease. MIL-H-17672D hydraulic fluid is used in the cranes and cross-deck winches. Through normal buoy operations, grease and hydraulic fluid are deposited on the deck (e.g., leaks) and contribute to deck runoff. Although the majority of this grease and hydraulic fluid is immediately cleaned up, some remains trapped in the rough deck surface and may contribute to deck runoff both inside and outside 12 nm (Wenzel *et al*., 2001a).

Wire rope on the cranes and cross deck winches are lubricated with grease MIL-G-18458B. The hydraulic system supplying the cranes and winches uses Texaco Rando HD 32 hydraulic fluid MIL-H-17672D, NSN 9150-01-087-3510. The potential materials contributing to deck runoff are hydraulic fluid MIL-H-17672D and MIL-G-18458B. The potential exists for these oils and lubricants to enter surrounding waters. The grease would have to fall onto the deck and be subsequently washed overboard; the hydraulic hoses would have to experience a failure. The amount that has the potential to enter surrounding waters could not be quantified (Wenzel *et al*., 2001a).

Table 5-3— Potential Discharge Materials for Buoy Handling

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Wire Rope Grease, MIL-G-18458B	1.4E+02	Phosphorous (yellow)	7723140	Unknown	Unknown	None
		Petroleum carriers	—	Unknown	Unknown	Unknown
Hydraulic Fluid, MIL-H-17672D	Unknown	Petroleum distillates	—	Unknown	Unknown	Unknown

Table 5-4— Narrative Parameters for Buoy Handling

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Colloidal Matter	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists
Nutrients	None
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
Pathogens	None
PH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment. The information is based on survey team recollection and consensus.

5.3 FIRE ASSIST VEHICLES

The CV/CVN 68 Class vessels have three flight deck fire trucks onboard the ship and the LHD 1 Class vessels have two. The survey team determined that the operation and maintenance of this equipment does not have the potential to contribute to deck runoff because while they are physically located on the flight deck during air operations (outside 12 nm), they are stored and serviced in the forward portion of the hangar bay in the ground support equipment (GSE) area (Wenzel *et al*., 2001a; Surgeon, 2002).

5.4 MINE HANDLING SYSTEMS

The survey team conducted an assessment of the systems aboard an MCM 1 Class vessel. Topside equipment includes: four cable reel assemblies, five winch assemblies, three winch control stations, three outrigger booms, two cranes, three mine tensioner payout systems, and a mine neutralization system (MNS) remotely operated vehicle. A 55 gal drum of lubricating oil, MIL-PRF-2105E, was carried onboard the vessel when underway to replenish the acoustic and magnetic cable reels and the stern crane. The bases of each of the three outrigger booms contained approximately 1 lb of water-resistant, general purpose MIL-G-24139A grease, that has the potential to contribute to deck runoff. In addition, the drive gear located on the acoustic cable reel was thinly coated with grease MIL-G-24139A. Finally, the hydraulically-operated cranes use MIL-H-17672D hydraulic fluid. Because the areas surrounding the base of these cranes and cable reels did not have containment devices to contain fluid, the potential does exist for constituents (hydraulic fluid MIL-H-17672D) to enter surrounding waters in the event of a spill resulting from a ruptured line or hose. Although these spills are not directly regulated by UNDS, the residual constituents trapped in the rough deck surface may contribute to deck runoff (Wenzel, 2000c).

The Navy has 14 MCM 1 Class vessels and 12 MHC vessels equipped with mine handling equipment. MIL-G-24139A grease is applied to the outrigger boom articulating pins. Each MCM 1 Class vessel has three booms; each boom contains approximately 1 lb of MIL-G-24139A grease. These pins are exposed to the weather and the potential exists for the grease to enter the water (Wenzel *et al*., 2001a).

Table 5-5— Potential Discharge Materials for Mine Handling Systems

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Multipurpose Grease, MIL-G-24139A	Unknown	Petroleum hydrocarbons	—	Unknown	Unknown	Unknown
Hydraulic Fluid, MIL-H-17672D	Unknown	Petroleum distillates	—	Unknown	Unknown	Unknown
Lubricating Oil, MIL-PRF-2105	Unknown	Petroleum hydrocarbons	—	Unknown	Unknown	Unknown

Table 5-6—Narrative Parameters for Mine Handling Systems

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists
Hardness	Unknown-not evaluated
Nutrients	None
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
Pathogens	None
PH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

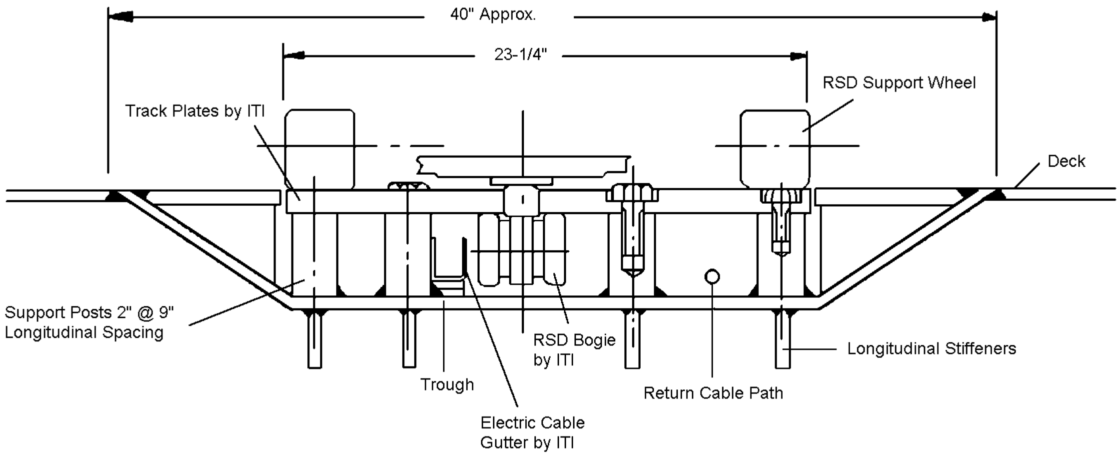
The need for the information in this table was not recognized at the time of the assessment. The information is based on survey team recollection and consensus.

5.5 RECOVERY, ASSIST, SECURING, AND TRAVERSING (RAST) SYSTEM

The recovery, assist, securing and traversing (RAST) system is designed for installation onboard vessels equipped with SH-60B helicopters. It is used to assist the helicopter to land safely on the flight deck, secure it immediately upon landing, safely transport it between the flight and hangar decks, and safely launch it during adverse weather conditions. Although the RAST system was not installed aboard DDG 51 Class vessels, it is installed on other vessels in the surface combatant category, (i.e., DD 963 (single and dual track), FFG 7, and CG 47 Class vessels). The survey team went aboard a CG 47 Class vessel to examine the RAST system and determine if it has the potential to contribute to deck runoff (Wenzel *et al*., 2001a).

The majority of the RAST system equipment is located below deck. Components located topside include the rapid securing device, electric cable reels, tail guide winch assembly, tracks, slot seals, and control console (See Figure 5-1). The rapid securing device (RSD) is housed inside the hangar bay while in port, and is moved to the flight deck only when necessary. If the RSD is moved to the flight deck when the vessel is in port, the RSD is covered with a form-fitting cover to prevent exposure to the environment. Track slot seals are installed in the traverse track slot to control the migration of water into the track during non-flight hours, between flight events when underway, when in port, and within 12 nm of shore (Wenzel *et al*., 2001a).

Figure 5-1. Cross Section of a Navy RAST System



The figure shows the trough for Navy RAST System. The trough is approximately 2 ft wide and 9 in deep. It acts as a guide for the Rapid Securing Device (RSD), and contains cables that are used to bring the helicopter to the deck and to move the helicopter along the track into the hangar. (Courtesy Indal Technologies Inc.)

The Navy has 98 vessels equipped with the RAST system. Because the assigned helicopters leave the vessel outside of the contiguous zone, the RAST system is not operated within 12 nm. As a result, only MIL-PRF-81322F grease applied to the traverse cables, located inside the tracks, and covered with slot seals, has a small potential to migrate to the non-skid surface and eventually contribute to deck runoff (Wenzel *et al*., 2001a).

The RAST system, used to assist helicopters to land safely on the flight deck of small platform vessels, is not used within the contiguous zone. The equipment uses MIL-PRF-81322F grease on the traverse cables, located inside the track covered with slot seals. Although the grease used is inside the track, the potential exists for grease to migrate to the non-skid surface and eventually contribute to deck runoff. The quantity that has the potential to enter surrounding waters could not be determined (Wenzel *et al*., 2001a).

Table 5-7— Potential Discharge Materials for Recovery, Assist, Securing and Traversing (RAST) system

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading	Any BCCs Present?
Grease, MIL-PRF-81322F	Unknown	Mixture of paraffinic, naphthenic, and aromatic hydrocarbons	—	Unknown	Unknown	Unknown

Table 5-8—Narrative Parameters for Recovery, Assist, Securing and Traversing (RAST) System

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists
Hardness	Unknown-not evaluated
Nutrients	None
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
Pathogens	None
pH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of assessment. The information is based on survey team recollection and consensus.

5.6 SHIP'S BOATS AND LAUNCHING SYSTEMS

Several vessel classes carry small boats that are used for various activities including lifeboats, law enforcement, supply transfers, and personal transfers. The boats are launched using either a crane or davit. The cranes or davits are connected to the boat by wire rope that is lubricated using various military standard greases including MIL-G-18458B and MIL-G-23549. The cables are also cleaned with MIL-PRF-680 Type III, a cleaning compound (Simple Green™), and JP-5 (MIL-DTL-5624T). Exposure to the rain and wind causes these lubricants to fall to the deck and contribute to deck runoff both inside and outside 12 nm. In addition, paint debris and residual hydraulic fluid from the cranes, fuels, soot, and cleaning compounds have the potential to become trapped in the rough deck surface and subsequently contribute to deck runoff discharge within the contiguous zone. Because the deck surfaces are cleaned outside 12 nm, only residual constituents will contribute to deck runoff within 12 nm.

In addition to the boat's launching systems, the engines of boats can be a source of deck runoff constituents. The engines of some of the smaller boats are run periodically on deck to ensure proper function. This operation deposits a mixture of constituents from the engine wet exhaust (e.g., fuel and soot) onto the deck of the vessel, creating the potential to contribute to deck runoff both inside and outside 12 nm.

5.6.1 AOE 6 Class

The AOE 6 Class carries six small boats that are equipped with Cummings engines, two 20 ft rigid hull inflatable boats (RHIBS), one 40 ft and one 50 ft fiberglass utility boats, one 35 ft aluminum work boat, and one 33 ft fiberglass captain's gig. All small boat engines are started and operated weekly for a period of 15 min to 30 min to ensure they run correctly. Upon retrieval, following an operation, the bilges are checked to ensure there is no oil in the bilge before the bilge plug is removed and the boat is hoisted onboard. Bilgewater is visually inspected to determine if oil, fuel, or other contaminants are present. If contaminants are present, the bilgewater is collected and turned in to the HAZMINCEN for disposal ashore. If the visual inspection determines that the bilgewater appears free of oil and particulates, it is discharged directly overboard (Surgeon, 2001). The small boats are removed from the vessel and painted only when in port, except for minor touch-up painting. All small boats are cleaned with a solution of 1 cup MIL-D-16791G general purpose detergent mixed with 5 gal of freshwater, which drains directly overboard, followed by a freshwater rinse. The constituents that have the potential to contribute to deck runoff include the detergent/water mixtures used to clean the boats, paint debris from minor touch-up painting (a drop cloth is used during painting activities to minimize this), and small boat engine wet exhaust resulting from the weekly onboard operations (Wenzel, 2000e).

The captain's gig and utility boats are retrieved and deployed using a double arm, pivoting, gravity davit that contains two drums housing 0.75 in wire rope. A boat-lifting boom that contains one drum of wire rope 125 ft in length is used to raise and lower the RHIB's. The cables are cleaned using MIL-DTL-5624T (JP-5) and lubricated with MIL-G-18458B wire rope grease. Prior to conducting maintenance, a drop cloth is spread on the deck to contain the cleaning compound and greases. The contributing constituents to deck runoff from the vessels' boats launching system are MIL-G-18458B and MIL-DTL-5624T (Wenzel, 2000e).

5.6.2 DDG 51 Class

The DDG 51 Class has two 24 ft RHIBS equipped with a diesel inboard/outboard engine, which uses MIL-DTL-5624T (JP-5) fuel. The RHIBS are removed from the vessel and taken to an intermediate maintenance facility for painting (Navy, 1998). However, the crew performs minor repairs to the fiberglass hull. When the RHIB is hoisted on board after operations, the bilge pump is disabled and residual bilgewater is wiped-up with a sponge and deposited in a bucket. The contents of the bucket are then emptied into a deep sink that drains to the vessels' graywater tank. The hull is cleaned with freshwater and general-purpose detergent. The survey team concluded that there is minimal potential of topside contamination from the RHIBS, as evidenced by the cleanliness of the deck area immediately below the boats (Wenzel, 2000b).

One electro/mechanical slewing arm davit (SLAD) with 110 ft of 0.75-inch wire cable is used to launch and recover the RHIBS. The cable is manually cleaned, on an annual basis, using 2 gal to 3 gal of MIL-PRF-680 Type III dry cleaning solvent and lubricated with 1 lb of MIL-G-23549 grease. A drop cloth is spread on the deck prior to conducting the maintenance in an effort to contain the materials and prevent the hazardous constituents from coming into contact with the deck. Because the wire cable is exposed to the environment, it is possible that some of the of MIL-G-23549 grease may drip from the cable to the deck under certain conditions, such as extreme temperature or rainfall (Wenzel, 2000b).

5.6.3 MCM 1 Class

Each MCM maintains two 17 ft 10 in RHIBS. Two MCM 1 Class vessels were assessed by the survey team. One vessel had two RHIBs equipped with a 90 hp and a 60 hp outboard engine, respectively. The second MCM 1 Class vessel had two RHIBS, each with a 90 hp outboard engine. The RHIBS are refueled using 6 gal gas cans filled from the 30 gal motor gasoline tank located on a jettison platform. The jettison platform is surrounded by a containment device and equipped with a plug and lanyard, that allows the crew to drain the containment device as needed. The outboard engines are operated daily for 2 min to 3 min, or as long as 15 min, at the discretion of the vessel's crew. The external surfaces and the bilge of the RHIBS are washed down with freshwater and a cleaning compound (Simple Green™) following every use and during major vessel cleanings. The primary constituents that have the potential to contribute to deck runoff are: (1) fuel residue from gasoline spilled when refueling the RHIB onboard vessel; and (2) contaminants resulting from the onboard operation of the outboard engines on a daily basis (Wenzel, 2000c).

One anti-magnetic electric hoist winch type BE-09 with a 1 in nylon rope with a lifting capacity of 2,000 lb is used to launch and recover the RHIBS. The nylon rope is static tested at twice the lifting capacity and operational testing is performed during the actual hoisting of the RHIBS. All load testing is performed by an outside activity when in port. The nylon rope is cleaned using freshwater. The nylon rope does not require lubrication and therefore would not contribute to deck runoff. The hoist assembly is cleaned with freshwater and a cleaning compound (Simple Green™) (Wenzel, 2000c).

5.6.4 WLM 175 Class

The WLM 175 Class vessel assessed had one 18 ft RHIB with a Yanmar four-cylinder engine and a Hamilton Jet inboard/outboard. The RHIB refueling station is enclosed by a 12 in high containment barrier. The RHIB is washed down following every use and during major vessel cleanings using a cleaning compound (Simple Green™). The primary constituent with the potential to contribute to deck runoff is residue from diesel fuel spilled during fueling operations and/or leaking fuel system fittings on the power plant (Wenzel, 2000a).

One Allied D6000 articulating crane with 0.5 in galvanized steel cable is used to launch and recover the RHIB from surrounding waters. The galvanized steel cable is greased using MIL-G-18458B. The hydraulic fluid used in the crane is Texaco Rando HD 32 hydraulic fluid (MIL-H-17672D). The primary constituent that contributes to deck runoff from vessel's boats launching systems is Texaco Rando HD 32 (Wenzel, 2000a).

5.6.5 WPB 110 Class

The WPB 110 Class carries one 17 ft RHIB with a 90 hp outboard engine with a through-prop exhaust system. The RHIB is refueled using gasoline supplied from 6 gal cans. Two 6 gal cans of gasoline and one 2.5 gal can of Shell 30W motor oil are maintained inside the RHIB and eight 6 gal cans of gasoline are maintained topside. The crew washes down the RHIB following every use and during major vessel cleanings using a cleaning compound (Simple Green™). The crew places a cover over the RHIB when the vessel is in port to protect it from the elements. The engine on each RHIB is operated for 2 min to 3 min each time the RHIBS are brought onboard (approximately 15 times a month). The primary constituents that have the potential to contribute to deck runoff are: (1) residue from gasoline spilled when refueling the RHIB onboard vessel; and (2) contaminants resulting from the onboard operation of the outboard engines on a daily basis. Small boat engine wet exhaust will be addressed separately under UNDS (Wenzel, 2000d).

One Electro/Hydraulic Sealift Appleton Marine Crane with 0.75 in cable is used to launch and recover the RHIB from surrounding waters. This crane uses NAPA Dextron III hydraulic fluid with a normal operating pressure of 1,800 psi, supplied from the crane's 15 gal reservoir located below deck. The crane has a lifting capacity of 1,750 lb. A cover is placed over the crane while the vessel is in port to protect the equipment from the weather and reduce corrosion. The cable is cleaned using MIL-PRF-680Type III and greased using MIL-G-18458B. A tarp is spread on the weather deck prior to cleaning and greasing the cable to contain the materials. The crane cable is lubricated with MIL-G-18458B and contributes to deck runoff (Wenzel, 2000d).

5.6.6 Summary of Petroleum, Oil, and Lubricants for Ship's Boats and Launching Systems

All of the vessels that were surveyed carried small utility and transport boats. The following table details the vessel class, number and types of boats, power plant and potential contributing constituents from ship's boats.

Table 5-9— Potential Ship's Boats Constituents by Vessel Class

Vessel Class	Boat Type	Number Onboard	Power Plant /Fuel	Potential Contributing Constituents
AOE 6	20 ft RHIB*	2	Diesel	JP-5/Diesel fuel MIL-DTL-5624T
AOE 6	40 ft Utility	1	Diesel	JP-5/Diesel fuel MIL-DTL-5624T
AOE 6	33 ft Captains Gig	1	Diesel	JP-5/Diesel fuel MIL-DTL-5624T
AOE 6	50 ft Utility	1	Diesel	JP-5/Diesel fuel MIL-DTL-5624T
AOE 6	35 ft Work Boat	1	Diesel	JP-5/Diesel fuel MIL-DTL-5624T
DDG 51	24 ft RHIB	2	Diesel	JP-5/Diesel fuel MIL-DTL-5624T
MCM 1	17 ft RHIB	2	Gasoline Outboard	Gasoline/outboard oil mixture 50:1 (portable fuel containers) Gas/oil/water exhaust on deck during test/maintenance runs
WLM 175	18 ft RHIB	1	Gasoline Outboard	Gasoline/outboard oil mixture 50:1 (portable fuel containers) Gas/oil/water exhaust on deck during test/maintenance runs
WPB 110	17 ft RHIB	1	Gasoline Outboard	Gasoline/outboard oil mixture 50:1 (portable fuel containers) Gas/oil/water exhaust on deck during test/maintenance runs

**Rigid-Hull Inflatable Boat*

The potential exists for residuals from leaking or spilled fuel to contribute to deck runoff. This fuel could be either MIL-DTL-5624T or the gasoline/oil mixture for the outboard motors. Because the fuel tanks for the JP-5/diesel powered boats are permanent tanks with hard-piped connections, it would require a system failure to cause a significant leak or a spill. The outboard motors, which use portable fuel canisters plumbed with rubber hose to the engine, have a greater potential to leak than the hard-piped systems (Wenzel *et al*., 2001a).

The maintenance/test runs for the outboards are conducted on deck. The outboards have through prop exhaust systems that discharge the engine cooling water and any residual gasoline/oil from the combustion process. Small boat engine wet exhaust is addressed separately under UNDS (Wenzel *et al*., 2001a).

Table 5-10— Potential Discharge Materials for Ship's Boats

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Fuel, MIL-DTL-5624T	Unknown	Kerosene	8008206	100	Unknown	Unknown
Detergent, MIL-D-16791G	Unknown	Nonylphenoxy (ethylenoxy) ethanol	—	> 99	Unknown	None
Gasoline/outboard oil mixture 50:1	Unknown	Unknown	—	Unknown	Unknown	Unknown
Soot from engine combustion	Unknown	Unknown	—	Unknown	Unknown	Unknown
Cleaning Compound (Simple Green^{TM})	Negligible	2-butoxyethanol	111762	< 6	Negligible	None

A full analysis was not conducted on soot, but may contain carbonaceous material, sulfates, and by-products of incomplete combustion of fuel.

Table 5-11— Narrative Parameters for Ship's Boats

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists, none observed
Hardness	Unknown-not evaluated
Nutrients	None
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
Pathogens	None
PH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of assessment. The information is based on survey team recollection and consensus.

The launching systems for small boats varied in design and materials used for maintenance. The table below details the vessel class, type of launching system, and materials used.

Table 5-12— Potential Ship's Boats Launching Systems Constituents by Vessel Class

Vessel Class	Launching System	Material Used
AOE 6	Double arm, pivoting, gravity davit with 0.75-inch wire rope	MIL-G-18458B grease MIL-DTL-5624T (to clean the cable)
DDG 51	Electro/mechanical slewing arm davit With 0.75-inch wire cable	1 lb. MIL-G-23549 grease 2-3 gal MIL-PRF-680 Type III (to clean the cable)
MCM 1	Anti-magnetic electric hoist with nylon line	None
WLM 175	Articulating crane with 0.5-inch galvanized steel cable	MIL-G-18458B grease Texaco Rando HD 32 used in crane (MIL-H-17672D)
WPB 110	Electro/hydraulic marine crane with 0.75-inch cable	MIL-G-18458B grease MIL-PRF-680 Type III (to clean the cable) NAPA Dextron III hydraulic fluid

Note: The crew onboard the AOE 6 and DDG 51 stated that they spread a tarp on the deck prior to performing maintenance to contain the cleaning compound and grease. The potential exists for some of the grease applied to the cables exposed to the environment to be washed off during a rainfall event and enter surrounding waters.

Table 5-13— Potential Discharge Materials for Ship's Boats Launching Systems

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Wire Rope Grease, MIL-G-18458B	Unknown	Phosphorous (yellow)	7723140	Unknown	Unknown	None
		Petroleum carriers	—	Unknown	Unknown	Unknown
General Purpose Grease, MIL-G-23549	Unknown	Petroleum Hydrocarbons	—	Unknown	Unknown	Unknown
Hydraulic Fluid, MIL-H-17672D	Unknown	Petroleum distillates	—	Unknown	Unknown	Unknown
Dry Cleaning Solvent, MIL-PRF-680 Type III	Unknown	High purity hydrocarbon solvents	—	100	Unknown	Unknown
Cleaning Compound (Simple Green™)	Negligible	2-Butoxyethanol	111762	<6	Negligible	None
Fuel, MIL-DTL-5624T	Unknown	Kerosene	8008206	100	Unknown	Unknown

Table 5-14— Narrative Parameters for Ship's Boats Launching Systems

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists
Hardness	Unknown-not evaluated
Nutrients	None
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
Pathogens	None
PH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment. The information is based on survey team recollection and consensus.

5.6.7 Painting and Preservation

Navy and USCG vessels carry small boats ranging in size from dinghies to utility boats. These craft are used to support the ship's mission (e.g., at-sea boardings and rescues, deployment and recovery of special ops teams, liberty launches and captains gigs) and are not capable of making independent voyages on the high seas. Most boats are built of aluminum, plastic, or fiberglass, while a small minority are made of wood. Rigid-hulled inflatable boats (RHIBS) are constructed of rubberized fabric pontoons with fiberglass hulls.

As previously discussed, Navy boats are removed from the vessel and taken to a shore intermediate maintenance facility for painting and hull repair. USCG boats are removed from the vessel and refurbished by an intermediate facility or contractor. If Navy boats require minor touch-up, the paint is removed using sand paper and/or a wire brush. A drop cloth is typically spread on the deck under the work area during paint removal and subsequent repainting. Following the repainting process, the work area is swept and vacuumed (if required); all paint debris is containerized and turned in to the HAZMINCEN for disposal ashore (Wenzel *et al.*, 2001a).

Each vessel maintained their boats in a similar manner. Below is a listing of vessels that the survey team observed, the boats carried onboard, and typical boat maintenance procedures.

Table 5-15—Boat Maintenance Procedures

Vessel Class	Boat Type	Number Onboard	Boat Maintenance Procedures
AOE 6	20-ft RHIBS 50-ft utility boat 40-ft utility boat 35-ft work boat 33-ft Captain's gig	2 1 1 1 1 1	All boats are removed from the vessel and taken to the Shore Intermediate Maintenance Facility for painting. Minor touch-up painting (using brushes) is occasionally performed underway at distances greater than 12 nm
DDG 51	24-ft RHIBS	2	The RHIBS are removed from the vessel and taken to the SIMA Shore Intermediate Maintenance Facility for painting and hull repair.
MCM 1	17 ft 10 in RHIBS	2	The RHIBS are removed from the vessel and taken to the Shore Intermediate Maintenance Facility SIMA for painting and hull repair.
WLM 175	18 ft RHIB	1	The RHIB is removed from the vessel and refurbished by the Maintenance Augmentation Team (MAT).
WPB 110	17 ft RHIB	1	The RHIB is removed from the vessel and refurbished by the MAT.

5.6.8 Cleaning Compounds

MIL-D-16791G general purpose detergent is used to clean the small boats onboard the AOE 6 and DDG 51 Class vessels. All other vessels surveyed reported using small amounts of a cleaning compound (e.g., Simple Green™). Cleaning was accomplished using a sponge or rag. Bilges and exterior surfaces were wiped clean. The survey team concluded that while cleaners were used in this process, the amounts were insignificant and could not be quantified (Wenzel *et al*., 2001a).

5.7 STORES HANDLING SYSTEMS

Information on equipment used to handle and transfer stores was obtained during the AOE 6 and DDG 51 assessments only. AOE 6 Class vessels have four very large stations used for replenishment-at-sea operations. Each station is comprised of kingposts, winch engines, wire rope and cable drums with sheaves and control systems. The DDG 51 surveyed was equipped with receiving stations for replenishment at sea consisting of a kingpost, easing-out-cleat, and easing-out-stabilizer. Although underway replenishment operations are conducted outside 12 nm, the potential exists for the grease (MIL-G-24139A and MIL-G-23549C) to be washed-off within 12 nm by rainwater, green water, or washwater. The conditions that could cause a portion of the grease to fall from the kingpost to the weather deck include extreme temperature and rainfall. Residual amounts of grease left on the deck could contribute to deck runoff. The quantity that has the potential to enter surrounding waters could not be quantified (Wenzel *et al*., 2001a).

Figure 5-2. Underway Replenishment (UNREP) Transfer of Stores

UNREP transfer of stores. Transfer from AOE 6 to hangar deck of CVN 73.
(Navy photograph by Bobbie G. Attaway)

Figure 5-3. UNREP Replenishment at Sea (RAS) Kingpost with Sliding Padeye

UNREP Replenishment At Sea (RAS) Kingpost with sliding padeye on 01 Level. AOE 3
(Photograph courtesy of Deepak Saha, M. Rosenblatt & Son – an AMSEC LLC Group)

5.7.1 AOE 6 Class

The stores transfer system consists of four replenishment-at-sea (RAS) stations. The RAS stations consist of a kingpost assembly and four winches that provide and control the cable required for highline transfer of stores. Each of the winches contain differing lengths and sizes of wire rope: (1) 900 ft of 1-in wire rope, (2) 900 ft of 0.75 in wire rope, (3) 700 ft of 0.75 in wire rope, and (4) 1,200 ft of 0.5 in wire rope. Each winch station is lubricated with approximately 5 gal of MIL-G-24139A general purpose grease. Each winch engine contains engine oil and hydraulic fluid. Each RAS station is lubricated with approximately 10 gal of the same grease. Although underway replenishment operations are conducted outside 12 nm, the potential exists for the grease to be washed-off during rainfall within 12 nm. Residual engine oil and hydraulic fluid from the winch engines also have the potential to become trapped in the rough deck surface and contribute to deck runoff (Baillargeon, 2001). The crew reported that the MIL-G-24139A grease on the kingpost also "sloughed-off" when exposed to the high temperatures in the Persian Gulf (Wenzel *et al*., 2001a).

5.7.2 DDG 51 Class

Two kingpost sliding padeyes are located amidships: one port and one starboard. The sliding padeye is used to transfer materials between vessels during underway replenishment operations, which are never conducted within 12 nm. Each sliding padeye is comprised of a stanchion with a 25 ft lead screw assembly, an easing-out cleat, and an easing-out stabilizer. Because the kingpost's lead screw is exposed to the environment, the estimated 1 qt of MIL-G-23549 grease (per padeye) may contribute to deck runoff, under certain conditions. The conditions under which a portion of the grease could be transferred from the kingpost to the weather deck include extreme temperature and/or rainfall (Wenzel, 2000b).

5.7.3 Summary of Petroleum, Oil, and Lubricants for Stores Handling Systems

AOE 6 Class vessels have four very large stations used for replenishment-at-sea operations. Each station is comprised of kingposts, winch engines, wire rope, and cable drums with sheaves and control systems. The DDG 51 surveyed was equipped with receiving stations for replenishment at sea consisting of a kingpost, easing-out-cleat, and easing-out-stabilizer. The materials used to lubricate the stores handling systems are listed below (Wenzel *et al*., 2001a).

Table 5-16— Potential Stores Handling Systems Constituents by Vessel Class

Vessel Class	Equipment	Potential Discharge Material	Amount
AOE 6	900 ft 1 in wire rope	Grease, MIL-G-24139A	5 gal
AOE 6	900 ft 0.75 in wire rope	Grease, MIL-G-24139A	5 gal
AOE 6	700 ft 0.75 in wire rope	Grease, MIL-G-24139A	5 gal
AOE 6	1200 ft 0.5 in wire rope	Grease, MIL-G-24139A	5 gal
AOE 6	Kingpost Assembly	Grease, MIL-G-24139A	10 gal
DDG 51	Kingpost/Sliding Pad-Eye Assembly	Grease, MIL-G-23549	0.25 gal

The DDG 51 receiving station does not have a containment structure around the kingpost assembly. Because the grease is continuously exposed to the elements, it presents significant potential to contribute to deck runoff if the grease washes off the lead screw assembly and onto the deck surface. Residual amounts of grease left on deck surfaces could contribute constituents to deck runoff. The survey team could not quantify the amount contributed to deck runoff by this equipment (Wenzel *et al*., 2001a).

The grease used on stores handling systems onboard AOE 6 Class vessels is continuously exposed to the elements and has the potential to contribute a significant amount of material to deck runoff. However, most of the grease would be deposited on the deck and the survey team observed the crew constantly cleaning the deck surfaces during RAS operation. The survey team was unable to quantify the amount contributed to deck runoff by this equipment (Wenzel *et al*., 2001a).

Information regarding the potential discharge materials and narrative parameters for stores handling systems is presented in the following tables.

Table 5-17— Potential Discharge Materials for Stores Handling Systems

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Multipurpose Grease, MIL-G-24139A	Unknown	Petroleum hydrocarbons	—	Unknown	Unknown	Unknown
General Purpose Grease, MIL-G-23549	Unknown	Petroleum hydrocarbons	—	Unknown	Unknown	Unknown

Table 5-18—Narrative Parameters for Stores Handling Systems

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists
Hardness	Unknown-not evaluated
Nutrients	None
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
Pathogens	None
PH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment. The information is based on survey team recollection and consensus.

5.8 TOWING AND MOORING SYSTEMS

Most routine towing jobs in the Navy are handled by harbor and fleet tugs. Combatant vessels can tow other vessels or be towed, but such operations are usually performed only in an emergency. The towing rig varies between vessel classes, but generally includes the following components: the towing/padeye (usually located on the centerline of the stern), a towing assembly (consisting of a large pelican hook shackled to the towing pad and hawser), and the hawser (wire rope) (Wenzel *et al*., 2001a).

Mooring a vessel to a pier, buoy, or another vessel requires the use of an anchor windlass: capstan: mooring lines: winches: fittings (e.g., cleats, bits, chocks, and shackles): and towing pads. Mooring lines are typically located at the bow, stern, and amidships. The survey team obtained towing and mooring system information during the AOE 6, DDG 51, MCM 1, WLM 175, and WPB 110 shipboard assessments. The crews perform all towing and mooring using multi-strand nylon line. No preservation measures are taken other than to inspect and replace the nylon line when required. Cleaning is limited to fresh or seawater rinses when required. As a result, the towing and mooring systems do not contribute to deck runoff (Wenzel *et al*., 2001a).

5.9 WEAPON SYSTEMS

The largest guns fitted on active Navy vessels are the 5 in MK 45 lightweight guns. These weapons are installed on cruisers and destroyers and are considered primarily shore bombardment weapons with limited anti-air capability. The 76 mm guns in Navy frigates and the larger USCG cutters are primarily anti-surface (shore and ship targets) weapons with limited anti-air capability. Most Navy surface warships are armed with the MK 15 20 mm Close-In Weapon System (CIWS) for short range defense against anti-ship missiles. In addition, Naval vessels are equipped with various types of 25 mm, 20 mm, .50-caliber, and 7.62 mm machine guns. These are primarily for defense against small craft in restricted waters. Weapon system information was obtained during surveys on the AOE 6, DDG 51, MCM 1, and WPB 110 Class vessels (Wenzel *et al*., 2001a). Three constituents may contribute to deck runoff during normal rainfall; MIL-G-21164D grease; MIL-L-63460D cleaner, lubricant and preservative; and MIL-PRF-680 Type III dry cleaning solvent.

5.9.1 AOE 6 Class

The AOE 6 Class has two MK 38 25 mm machine guns, four .50-caliber M2HP machine guns, two MK 15 CIWS, and one dual box missile launcher. All gun mounts are cleaned using freshwater and MIL-D-16791G general-purpose detergent. MIL-L-63460D cleaner, lubricant and preservative is applied to the .50-caliber gun mounts and the MK38 25 mm gun mount. The gun mounts are covered when not in use. However, the crew indicated that because the covers do not maintain integrity, rusting gun mount components is a continual problem. Because the weapon systems are covered and minimal materials are used to maintain the systems, they do not have the potential to contribute to deck runoff (Wenzel, 2000e).

5.9.2 DDG 51 Class

DDG 51 Class weapon systems include: one MK 45 5”/54-caliber lightweight gun mount, two MK 41 vertical launch systems (VLS), two MK 15 CIWS, two MK 32 MOD 14 triple-barrel torpedo tubes, two .50-caliber machine gun mounts, and two MK 36 MOD 12 Super Rapid-Blooming Offboard Countermeasures (SRBOC) chaff and decoy launching systems. The majority of materials, (e.g., grease and oils) that are used on the weapons systems are used on internal components and therefore do not have the potential to contribute to deck runoff. However, three materials used on the external surfaces of DDG 51 Class weapons systems were identified as having the potential to contribute to deck runoff: (1) MIL-G-21164D grease; (2)

MIL-PRF-680 Type III dry cleaning solvent; and (3) MIL-L-63460D cleaner, lubricant and preservative. Interviews with the crew revealed that approximately 30 % to 35 % of the 16 oz. of MIL-G-21164D that is applied to the gun mount chase is washed-off during a normal rainfall. The crew also estimated that approximately 50 % of the 2 oz of MIL-L-63460D cleaner, lubricant, and preservative applied to the .50-caliber gun mount is washed-off during a normal rainfall (Wenzel, 2000b).

5.9.3 MCM 1 Class

The MCM 1 Class vessels are equipped with two .50-caliber machine guns and two M60 machine guns. All gun mounts are cleaned using freshwater and a cleaning compound (Simple Green™). MIL-L-63460D cleaner, lubricant, and preservative is applied to the gun mounts. Covers are installed on the gun mounts when the vessel is in port to protect the equipment from the weather and to prevent corrosion (Wenzel, 2000c).

5.9.4 WPB 110 Class

The WPB 110 Class vessels are equipped with one MK38 25 mm machine gun and two .50-caliber M2HP machine guns. All machine guns are cleaned using freshwater and a cleaning compound (Simple Green™). Approximately 2 oz. of MIL-L-63460D cleaner, lubricant and preservative is applied to each .50-caliber gun mount and the MK38 25 mm gun mount. Covers are installed on the guns when the vessel is in port to protect the equipment from the weather and prevent corrosion (Wenzel 2000d). Because machine guns are covered when in port, the only constituent that has the potential to contribute to deck runoff is MIL-L-63460D. However, the potential only exists if the vessel is operating in the contiguous zone during rainfall or heavy seas (Wenzel *et al*., 2001a).

5.9.5 Summary of Petroleum, Oil, and Lubricants for Weapon Systems

The survey team concluded that other than the 5”/54-caliber lightweight gun mount and the .50-caliber gun mount, weapon systems do not contribute to deck runoff (Wenzel *et al*., 2001a). The weapon system information is detailed in the following table.

Table 5-19— Potential Weapons Systems Constituents by Vessel Class

Vessel Class	**Weapon System**	**Potential Discharge Material**
AOE 6	MK 38 25 mm machine guns (2)	Cleaner, lubricant, and preservative MIL-L-63460D
AOE 6	CIWS (2)	Cleaner, lubricant, and preservative MIL-L-63460D
AOE 6	M2HP .50-caliber machine guns (4)	Cleaner, lubricant, and preservative MIL-L-63460D
DDG 51	MK 45 5”/.54-caliber lightweight gun mount (1)	Grease, MIL-G-21164D
DDG 51	MK 41 vertical launch system (2)	None
DDG 51	MK 32 MOD 14 triple barreled torpedo launcher (2)	None
DDG 51	CIWS (2)	Cleaner, lubricant, and preservative MIL-L-63460D
DDG 51	M2HP .50-caliber machine gun (2)	Cleaner, lubricant, and preservative MIL-L-63460D
MCM 1	M2HP .50-caliber machine gun (2)	Cleaner, lubricant, and preservative MIL-L-63460D
WPB 110	MK 38 25MM rapid fire, fixed mount (1)	Cleaner, lubricant, and preservative MIL-L-63460D
WPB 110	M2HP .50-caliber machine gun (2)	Cleaner, lubricant, and preservative MIL-L-63460D

Based on ship survey evaluations and crew estimates, the fleet-wide discharge of MIL-G-21164D grease from the MK 45 5”/.54-caliber lightweight gun mount is calculated as follows (Wenzel *et al*., 2001a).

1. Approximately 5.0 oz of grease is released during each typical rain event.
   (16 oz/unit × 30 %/event = 5.0 oz/unit-event)

2. A weapon unit that is exposed to 24 typical rain events per year would generate an estimated annual grease release of 120 oz.
   (24 events/yr × 5.0 oz/unit-event = 120 oz/unit·yr)

3. With 228 heavy weapon units in the fleet (166 of the 5”/54 guns and 62 of the MK 75 guns), the annual fleet-wide grease release is estimated to be 27,000 oz.
   (120 oz/unit·yr × 228 units/fleet = 27,000 oz/fleet·yr)

4. Based on a fleet wide average of approximately 50 % time spent pierside or transiting within 12 nm, the grease released within 12 nm is estimated to be 13,500 oz.
   (27,000 oz/fleet·yr × 50 % = 13,500 oz/fleet·yr)

The fleet-wide discharge of MIL-G-63460 grease from the .50-caliber gun mount is calculated as follows (Wenzel *et al*., 2001a):

1. Approximately 1 oz of grease is released during each typical rain event.
   (2 oz/unit × 50 %/event = 1 oz/unit-event)

2. Assuming 24 rain events per year, the annual per weapon unit grease release is estimated to be 24 oz.
   (24 events/yr × 1 oz/unit-event = 24 oz/unit·yr)

3. With 416 total weapon units in the fleet, the annual fleet-wide grease release is estimated to be 10,000 oz.

(24 oz/unit·yr × 416 units/fleet = 10,000 oz/fleet·yr)

4. Based on a fleet-wide average of 50 % of time at pierside or transiting within the 12 nm, grease released is estimated to be 5,000 oz/fleet·yr.
(10,000 oz/fleet·yr × 50 % = 5,000 oz/fleet·yr).

Table 5-20— Potential Discharge Materials for Weapon Systems

Potential Discharge Material	Potential Discharge Volume (oz/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (oz/fleet·yr)	Any BCCs Present?
Grease, MIL-G-21164D	1.4E+04	Synthetic ester	—	> 74	> 1.0E+04	None
		Lithium based soap thickener	—	> 12	> 1.6E+03	None
Cleaner, lubricant and preservative, MIL-L-63460D	5.0E+03	Unknown	—	Unknown	Unknown	Unknown
Dry Cleaning Solvent 6850-00-274-5421 (MIL-PRF-680 Type III)	Unknown	High purity hydrocarbon solvents	—	100	Unknown	Unknown

Table 5-21—Narrative Parameters for Weapon Systems

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Colloidal Matter	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists
Hardness	Unknown-not evaluated
Nutrients	None
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
Pathogens	None
pH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment. The information is based on survey team recollection and consensus.

5.10 PERFORMANCE OBJECTIVE AND ACTIVITIES

The objective of the TMP for this category is for the vessel's responsible party to prevent the discharge of cleaning compounds, greases, hydraulic fluids, solvents, oils, fuels, and other materials associated with deck machinery and weapons lubrication that may negatively impact water quality. Activities that could be performed to meet this performance objective include, but are not limited to: using a wire rope lubricator and using covers or protective devices.

Currently, some vessels use rags to apply and remove grease from cables. This process results in the application of excessive grease that then has the potential to fall to the deck. Although grease deposits are cleaned up upon discovery, some grease can become trapped in the rough deck surface and contribute to deck runoff. This activity consists of using a wire rope lubricator to remove and apply grease to cables (Kirkpatrick, 1999). The wire rope lubricator applies grease under pressure to drive out moisture-contaminated old grease from internal and external wire strands and scrapes off this used grease using a groove cleaner (Kirkpatrick, 1999). The used grease is deposited in a bucket located under the scraper, where it can be containerized for proper disposal (Kirkpatrick, 1999). Using a wire rope lubricator reduces the amount of excessive grease because the grease is primarily applied to the internal sections of the wire rope, not the exterior. Reducing the amount of surface grease reduces the amount of grease that has the potential to fall off onto the deck and subsequently contribute to deck runoff.

Grease applied to deck machinery and weapons contribute to deck runoff. Using weatherproof covers or protective devices prevents grease and oil from falling or being blown or washed to the deck or directly overboard, therefore reducing the amount of grease and oil that may contribute to deck runoff. Examples of activities that use covers or protective devices are as follows:

> Installing chafing guards at friction points on exposed hydraulic hoses prevents chafing of hydraulic hoses therefore minimizing leaks from these hoses.
>
> Installing extensions on winch engine oil drains enables the crew members to drain the dirty oil directly into a container, facilitating a more efficient oil collection and minimizing the potential for a spill.
>
> Installing weatherproof, form fitted covers with fasteners (zippered or snap) on cranes and weapons systems would reduce the exposure of grease and hydraulic fluid to rain and seawater, thereby reducing the contribution of grease and hydraulic fluid to deck runoff.
>
> Installing sample fittings on winch engines would allow crew members to collect samples of hydraulic fluid without disturbing the integrity of the hydraulic system. Because the crew member does not have to disconnect any hydraulic lines to obtain the actual sample, the potential contribution of hydraulic fluid to deck runoff is reduced.
>
> Finally, using tarps (stored below decks when not in use) during routine maintenance of deck machinery and weapons systems prevents the grease and oil from falling to the deck where they may contribute to deck runoff both inside and outside 12 nm.

6.0 EXTERIOR TOPSIDE SURFACE PRESERVATION

Exterior topside surface preservation primarily includes restoration of coated (painted or non-skid covered) surfaces and maintenance of flight safety nets. The removal of failed surface coatings has the potential to contribute to deck runoff primarily in the form of paint chips, non-skid material, and rust and other corrosion by-products. Paint drips do not have the potential to contribute to deck runoff because drop cloths are used while applying the paint and any drips that do not fall on the drop cloth are spot cleaned with a rag and solvent immediately. Paint chips, non-skid material, and rust and other corrosion by-products have the potential to become trapped in the rough deck surface and subsequently contribute to deck runoff discharge within the contiguous zone. When the exterior topside surfaces are cleaned outside 12 nm, there would only be residual constituents in the discharge within 12 nm. The survey team found that the flight safety net maintenance, which consists of applying MIL-G-23549 grease to hinge pins and scrubbing netting outside of 12 nm, does not contribute to deck runoff.

6.1 RESTORATION OF PAINTED SURFACES

The survey team obtained information on the restoration of painted surfaces during every shipboard assessment. Based on these observations, the survey team determined that paint chips and rust and other corrosion by-products that do not fall on the drop cloth and are not recovered by crew actions (sweeping, mopping or vacuuming), may wash overboard into the surrounding waters and are the primary constituents that have the potential to contribute to deck runoff. However, the survey team was unable to accurately estimate the amount.

6.1.1 AOE 6 Class

The crew removes deck and superstructure paint using needle guns, disc sanders, grinders, sandpaper and wire brushes. No chemical paint removers are used. Waste paint debris is containerized and turned into the HAZMINCEN for disposal ashore. Surfaces are painted using brushes and rollers; they are rough-sanded and then wiped-down with a mixture of general purpose detergent and freshwater prior to painting. If the crew is touching up the hull paint while the vessel is in port, drop cloths are suspended between the vessel and the pier to catch paint debris and paint drips (Wenzel, 2000e).

6.1.2 CV/CVN 68 Class

The flight deck is covered with a non-skid surface coating, which is removed and applied by a contractor during the vessels' periods of availability. Only spot repairs of small areas are made while underway. If spot repairs are required, the crew removes the non-skid using hand operated deck grinding machines. No chemical agents are used to help remove the non-skid surface. Waste materials from the non-skid removal are swept, containerized, and turned into the HAZMINCEN for disposal ashore. Deck maintenance and preservation does not contribute to deck runoff (Wenzel *et al*., 2001b).

6.1.3 DDG 51 Class

Deck and superstructure paint is applied using brushes and rollers. Paint removal methods include needle guns, disc grinders, sandpaper and wire brushes. Neither the needle guns nor the disc grinders on the vessel surveyed by the team were vacuum-assisted. During the assessment, the survey team observed a sailor removing paint from a metal door using a grinder. The sailor had taken the precaution of placing the metal door on a drop cloth to contain the debris; upon completion of his task, the debris that had projected beyond the drop cloth was swept, containerized, and turned into the vessel's HAZMINCEN. All weather deck surfaces are coated with non-skid material that is applied/removed by contractor personnel during the vessel's repair availability period. Although the crew exercises caution and takes preventive measures to ensure paint debris and non-skid material do not enter the surrounding water, paint chips and non-skid material do have the potential to contribute to deck runoff during deck and superstructure maintenance and preservation (Wenzel, 2000b).

6.1.4 LHD 1 Class

A fresh non-skid surface coating was applied to the flight deck ten months prior to the assessment. All of the vessels surveyed have indicated that only spot repairs of the non-skid surface are made when underway; new non-skid is removed and applied by a contractor during vessel's periods of availability. Spot repairs had not been made since the vessel began its deployment three months prior to the assessment. The crew stated that if spot repairs are required prior to returning to port, they will remove the non-skid using hand operated deck grinding machines, no chemical removers will be used. Waste materials will be swept, containerized, and turned into the HAZMINCEN for disposal ashore. As a result, flight deck maintenance and preservation does not contribute to deck runoff (Wenzel *et al*., 2001a).

6.1.5 MCM 1 Class

MCM 1 Class vessels are constructed of glass reinforced plastic, sheathed wood (i.e., laminated oak framing and Douglas fir planking), and deck sheathing. Care is taken to maintain and preserve the vessels' hull, decks, and superstructure. Surfaces are cleaned with freshwater and a cleaning compound (Simple Green™) prior to painting, and nearly 80 % of the time, only sandpaper is used to prepare the surface for painting. Deck/superstructure paint is applied using brushes and rollers and removed using sandpaper, grinders, or vacuum-assist disc sanders. No chemical paint removers are used in the vessel's preservation process. Spray painting is not performed onboard the vessel, and no solvents or thinners are used when painting. Waste materials are swept and containerized for shoreside disposal. Almost all (approximately 90 % to 95 %) of the painting is performed while pierside. The remaining 5 % to 10 % is limited to touch-up work which is performed when underway. Brushes and rollers are cleaned with solvents in the paint locker below deck. Activities conducted in the paint locker do not contribute to deck runoff (Wenzel, 2000c).

6.1.6 WLM 175 Class

Other than touch-up painting of buoys, no painting is performed underway on these vessels. The vessels' hull and superstructure are painted only in port and is normally limited to touch up painting. Complete hull painting is performed during dry dock availability. Surface preparation is performed using a wire brush. All residual paint chips are swept-up and containerized for disposal ashore. The surveyed hull was painted once in the 14 months prior to the survey team's assessment. Paint used by the surveyed WLM 175 Class vessel is manufactured by Interlux. Specific color information is Interlac 800, White; Interlux Premium Yacht Enamel #344, International Orange; and Interlux Brightside Polyurethane #4253, Ocean Blue. These paints are the primary materials that contribute to deck runoff in the form of paint chips due to deck/superstructure maintenance and preservation that arise from touchup painting (Wenzel, 2000a). However, while the surveyed cutter reported use of Interlux paint, this is not representative of the WLM 175 fleet. COMDTINST M10360.3B, Coating and Color Manual, does not currently authorize Interlux paint. Inorganic or organic zinc primers w/ either Epoxy Polysiloxane (Ameron PSX-700) or Silicone Alkyd Enamel (MIL-PRF-24635) as a topcoat are authorized topside paint systems. [Note: this paint system applies to all exterior topside steel surfaces in CG fleet]. The specific color scheme used is listed in Chapter 11 of the COMDTINST M10360.3B, using the FED-STD-595 standard color number (U.S. Coast Guard, 2001b).

6.1.7 WPB 110 Class

The crew removes deck and superstructure paint from WPBs using needle guns, disc sanders with recovery vacuum, palm sanders with dust collection bags, sandpaper, and wire brushes. No chemical paint removers are used. Paint debris is swept and containerized for disposal ashore. The hull above the waterline is painted every six months, and is rough-sanded and wiped-down with denatured alcohol and rags prior to painting the surfaces with brushes and rollers. The crew uses paint manufactured by Interlux; specific color information is Interlac 800, White; Interlux Premium Yacht Enamel #344, International Orange; and Interlux Brightside Polyurethane #4253, Ocean Blue (Wenzel, 2000d). However, while the surveyed cutter reported use of Interlux paint, this is not representative of the WPB 110 fleet. COMDTINST M10360.3B, Coating and Color Manual, does not authorize Interlux paint. Inorganic or organic zinc primers w/ either Epoxy Polysiloxane (Ameron PSX-700) or Silicone Alkyd Enamel (MIL-PRF-24635) as a topcoat are authorized topside paint systems. [Note: This paint system applies to all exterior topside steel surfaces in CG fleet]. The specific color scheme used is listed in Chapter 11 of the COMDTINST M10360.3B, using the FED-STD-595 standard color number (U.S. Coast Guard, 2001b).

6.1.8 Painting and Preservation

Shipboard maintenance and preservation activities are conducted both in port and underway on all Armed Forces vessels. Factors that affect the frequency and scope of the maintenance and preservation requirements include:

- Vessel size (larger vessels require more paint related maintenance);
- Vessel age (older vessels require frequent upkeep);
- Operational requirements (air-capable vessels require more repair/preservation due to aircraft operations);
- Climatic conditions (vessels operating in the Gulf are subjected to sand storms; vessels operating in the North Atlantic are subject to ice storms); and
- Manning level and crew experience (minimal manning levels may result in less preservation; lower experience levels may result in poor preservation practices).

When the vessel’s crew followed good work practices, including drop cloths spread on the deck under and around the work area, the majority of the paint debris remains on the drop cloth. The following devices are used: sandpaper, wire brushes, needle guns, grinders, chipping hammers, and deck crawlers. Some of these devices are equipped with vacuum recovery systems. During cleanup operations, the crew sweeps and containerizes the debris for disposal. Vacuum cleaners are then used to remove fine debris not recovered during sweeping. Immediately following the cleanup process, the survey team visually observed the deck surfaces to identify the presence of paint chips on the deck surface; no paint chips were noted during any of the assessments. As a result, the survey team cannot quantify, or reasonably estimate, a release or potential release of constituents resulting from this process (Wenzel *et al*., 2001a).

Table 6-1— Potential Discharge Materials for Restoration of Painted Surfaces

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Paint chips/debris (If below waterline)	Unknown	Copper as cuprous oxide	7440508	47	Unknown	Reduction
		Zinc as zinc oxide	7440666	15	Unknown	Reduction
Paint chips/debris (If above waterline)	Unknown	Unknown	---	Unknown	Unknown	None

6.2 FLIGHT DECK SAFETY NETS

Flight deck safety nets are located on all air capable vessels to provide a measure of protection against personnel falling overboard. The survey team observed and documented the maintenance of flight deck safety nets during the AOE 6, CV/CVN 68, DDG 51, and LHD 1 Class assessments. Because cleaning of safety nets occurs outside 12 nm from shore, any effluent generated is not subject to UNDS.

6.3 PERFORMANCE OBJECTIVE AND ACTIVITIES

The objective for this exterior topside surface preservation is for the vessel's responsible party to prevent the discharge of rust (and other corrosion by-products), cleaning compounds, paint chips, non-skid material fragments, and other materials associated with exterior topside surface preservation that may negatively impact water quality. Activities that could be performed to meet this performance objective include, but are not limited to: performing general housekeeping, such as sweeping and/or mopping, on the affected areas; using drop cloths when removing and applying paint; and using vacuum-assisted needle guns, sanders, and grinders.

Naval Ship's Technical Manual (NSTM) Chapter 631, the Preservation of Ships in Service, requires vessels to perform general housekeeping while conducting paint removal and application. Any paint chips that are collected are held for proper disposal at a shoreside HAZMINCEN (Navy, 1999). Performing general housekeeping following painting activities prevents the discharge of rust, cleaning compounds associated with painting activities, paint chips, and other materials associated with painting activities from contributing to deck runoff.

Using of drop cloths during both paint removal and application collects paint chips and over spray before they are deposited on the deck and contribute to deck runoff. Drop cloths are reused until their condition warrants disposal. All paint chips and unusable drop cloths are collected and held for proper disposal at a shoreside HAZMINCEN (Navy, 1999, 2002).

Some paint removal equipment (e.g., needle guns, sanders, and grinders) have built in vacuums that collect paint chips and dust as they are generated, reducing the amount of constituents that could be deposited on the deck and contribute to deck runoff. A vacuum-assisted system consists of a central vacuum unit with the individual tools attached. Various sizes of vacuum-assisted systems are available, from single tool to ten tool units. The vacuum bags can be either disposable or reusable (Clayton Associates, 2001). For Navy vessels, the chips, dust, and disposable bags are removed from the vacuum for proper disposal at a shoreside HAZMINCIN (OPNAVINST 5090.1B). For USCG vessels paint chips, dust, and disposable bags are disposed of in accordance with Commandant Instruction (COMDTINST) M16478.1B, the Hazardous Waste Management Manual. For U.S. Army vessels, paint chips, dust, and disposable bags are disposed of in accordance with Technical Manual 43-0139, Painting Instructions for Army Materiel.

7.0 VESSEL, AIRCRAFT, AND VEHICLE REFUELING AND LUBRICATION

Vessel, aircraft, and vehicle refueling and lubrication were assessed on CV/CVN, AOE 6, and LHD 1 Class vessels. Aircraft refueling can occur inside and outside 12 nm. Although spills are cleaned up, residual aircraft fuel (JP-5) may contribute to deck runoff. In addition to fuel, small amounts of general purpose cleaner, grease, and anti-seize compounds are used at the fueling stations. Fixed wing aircraft maintenance may contribute to deck runoff in the form of hydraulic fluid, and aircraft grease. Residual amounts of fuel, hydraulic fluid, grease, and anti-seize compounds may become trapped in the rough deck surface and subsequently contribute to deck runoff within 12 nm.

7.1 AIRCRAFT REFUELING

Vessels that refuel aircraft are classified as either aviation vessels (e.g., aircraft carriers) or air capable vessels (e.g., destroyers and cutters). Armed Forces air capable vessels are listed in Operational Naval Instruction (OPNAVINST) 3120.35J (Navy, 2000) and range in size from 210 ft USCG medium endurance cutters (WMEC 210) to aircraft carriers (CV/CVN 68). Most aircraft refueling occurs while the aircraft are on deck. However, some vessel classes, such as the DDG 51, FFG 7, and WHEC 378 have helicopter in-flight refueling (HIFR) capabilities.

JP-5 jet fuel (MIL-DTL-5624T) is the only jet fuel authorized to be used aboard Navy vessels and carried by fleet oilers (Navy, 1996). JP-5 is a "middle distillate [,] specially blended kerosene". It is characterized by "high concentrations of cycloalkanes and n-alkanes, lower concentrations of monoaromatics and branch alkanes, and very low concentration of benzene, toluene, ethylbenzene and xylenes (BTEXs) and polynuclear aromatic hydrocarbons (PAHs)" (Potter and Simmons, 1998).

Aircraft refueling activities can occur inside and outside 12 nm. Sources of JP-5 spills include aircraft tank vents, tank relief valves, and fueling station drains. On aircraft carriers (CVN and CV Classes), which are the vessels with largest number of aircraft (approximately 85 aircraft per carrier), approximately 20 gal of JP-5 spill during a 24 hr period of aircraft operation. On aircraft carriers, dedicated spill carts recover JP-5 from the deck, however, the efficiency of this recovery method has not been determined. JP-5 is not expected to remain on deck for long periods of time following aircraft refueling activities. Therefore, aircraft refueling activities are not likely to contribute significant amounts of JP-5 constituents to deck runoff (Wenzel *et al*., 2001a).

7.1.1 CV/CVN 68 Class Petroleum, Oil, and Lubricants

For the CV/CVN Class, maintenance performed on refueling equipment located topside includes inspecting and lubricating hose reel assemblies, inspecting hose and nozzle assemblies, and lubricating the defueling pump (used for evacuating fuel hoses after fueling aircraft). The majority of fueling/defueling station maintenance is performed on equipment that is located below decks. Aircraft fueling stations are cleaned on a weekly basis using a cleaning compound (Spray & Wipe™) and rags. Preservation is accomplished only during periods of repair availability. Drains located in the fueling station discharge directly overboard as a fire safety measure (Wenzel *et al*., 2001a).

The survey team did not notice any fuel spilled during the more than 20 aircraft fueling evolutions observed. However, the crew stated that an average of 20 gal of MIL-DTL-5624T jet fuel (JP-5) from aircraft tank vents and tank relief valves/dumps is spilled on the deck during a 24-hr period. A dedicated fuel spill cart is maintained on the flight deck to provide rapid spill response; the recovered fuel is transferred to the contaminated fuel tank. All fuel remaining in the fuel hose is evacuated prior to the release of the hose from the aircraft. Fuel that has spilled onto the deck from the tank vents and valves may become trapped in the rough deck surface and contribute to deck runoff within 12 nm (Wenzel *et al*., 2001a).

The fueling stations are cleaned outside 12 nm after the departure of the air wing. Residual amounts of JP-5 spilled on the deck from the tank vents and valves may become trapped in the rough deck surface and subsequently contribute to deck runoff within 12 nm.

7.1.2 LHD 1 Class Petroleum, Oil, and Lubricants

For the LHD 1 Class, maintenance performed on topside equipment includes: lubricating the de-fueling pump; inspecting and lubricating the hose reel assemblies; and inspecting and lubricating the hose and nozzle assemblies. Most of the maintenance is performed on equipment located below decks and therefore does not contribute to deck runoff. Aircraft fueling stations are cleaned on a weekly basis using a cleaning compound (Spray & Wipe™). Preservation of the aircraft fueling station equipment is accomplished during periods of repair availability (Wenzel *et al*., 2001a).

Sources of JP-5 spills are aircraft tank vents and tank relief valves/dumps. The crew maintains a dedicated fuel spill cart on the flight deck to provide rapid spill response; the recovered fuel is transferred to the contaminated fuel tank. Drip pans are not used when fueling/defueling aircraft because they are a potential safety and equipment hazard. All fuel remaining in the fuel hose is evacuated prior to hose release from the aircraft. The survey team did not note any fuel spillage during the aircraft fueling evolutions observed. The fueling station drains discharge directly overboard (Wenzel *et al*., 2001a).

The fueling station is cleaned outside 12 nm after the departure of the air wing. The drains are open when underway, and closed when the vessel is in port. Residual amounts of JP-5 spilled on the deck from the tank vents and valves may become trapped in the rough deck surface and subsequently contribute to deck runoff within 12 nm.

7.1.3 AOE 6 Class Petroleum, Oil, and Lubricants

The AOE 6 Class vessel's crew is responsible for performing all maintenance on the fueling station. After refueling an aircraft, the fueling hose is drained into a bucket, and the fuel is poured into the contaminated fuel tank. The survey team observed the aircraft refueling process several times and did not observe any spillage. Very small amounts of cleaning and lubricating materials are used on the aircraft fueling station, including: MIL-D-16791G general-purpose detergent; DOD-G-25408 grease, and anti-seize compound MIL-A-907. The AOE 6 Class vessels can carry 3 rotary wing aircraft (Federation of American Scientists, 1999). Although the survey team concluded that aircraft refueling evolutions could contribute to deck runoff on CVN 68 Class vessels (carrying approximately 85 aircraft (Federation of American Scientists, 2000)), due to the small number of aircraft on the AOE 6, the survey team concluded that it did not have the potential to contribute to deck runoff generated by AOE 6 Class vessels. The survey team concluded that the refueling process on AOE 6 Class vessels did not have the potential to contribute to deck runoff (Wenzel *et al*., 2001a).

7.1.4 Summary of Petroleum, Oil, and Lubricants for Aircraft Refueling

CV/CVN 68 Class vessels spill approximately 20 gal of JP-5, MIL-DTL-5624T jet fuel daily. Aircraft fuel tank venting and malfunctioning equipment cause these spills. The crew immediately cleans up all spilled fuel. No spills were noted during the LHD 1 or AOE 6 shipboard assessments. It is important to note that all air operations occur outside 12 nm and the flight decks are thoroughly cleaned prior to transiting within 12 nm, with the exception of the AOE 6 class vessels. Because aircraft from the AOE 6 depart closer to shore than other aircraft, the final exterior topside surface washdown may occur within 12 nm. The potential does exist for trace amounts of fuel to be trapped in the rough non-skid deck surface to subsequently contribute to deck runoff within 12 nm.

Table 7-1— Potential Discharge Materials for Aircraft Fueling

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Fuel, JP-5 MIL-DTL-5624T	Unknown	Cycloalkanes	---	Unknown	Unknown	None
		n-Alkanes	---	Unknown	Unknown	None
		Monoaromatics	---	Unknown	Unknown	Unknown
		Branched alkanes	---	Unknown	Unknown	Unknown
		Benzene	71432	Unknown	Unknown	None
		Toluene	108883	Unknown	Unknown	None
		Ethylbenzene	100414	Unknown	Unknown	None
		Xylenes	1330207	Unknown	Unknown	None
		PAHs	---	Unknown	Unknown	Elimination & Reduction

Table 7-2—Narrative Parameters for Aircraft Fueling

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Colloidal Matter	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists
Hardness	Unknown-not evaluated
Nutrients	None
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
Pathogens	None
PH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Transparency	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment. The information is based on survey team recollection and consensus.

7.2 FIXED WING AIRCRAFT MAINTENANCE AND OPERATIONS

Only the Navy aircraft carriers (CV and CVN Class designation) and amphibious assault vessels (LH 1 and LHA 1 Classes) carry fixed wing aircraft. Typical aircraft maintenance procedures that could produce deck runoff constituents include repairs to hydraulic lines and aircraft lubrication. Aircraft hydraulic fluid (MIL-PRF-83282D) contains more than 65 % of synthetic hydrocarbon base oil and less than 35 % of lubricant ester base. Aircraft grease (MIL-PRF-81322F) is mostly a complex mixture of paraffinic, napthenic, and aromatic hydrocarbons. Although leaks and spills from hydraulic fluid lines and lubrication activities are immediately cleaned after detection, the possibility exists for trace amounts to remain on deck and contribute to deck runoff discharge.

7.2.1 CV/CVN 68 Class

The survey team conducted a survey of the aviation support systems aboard a CV/CVN 68 Class vessel. The flight decks of aircraft carriers are large (> 4.5 acres), flat surfaces with a small (70 ft by 25 ft) island structure that houses the flight deck control tower, primary flight control, various bridges, and two auxiliary jet fuel stations. Unlike other vessels, the carrier flight deck has limited fixed topside equipment. Fixed equipment consists of arresting wires and barricade stanchions, jet blast deflectors, and catapult trough components. Most topside processes are performed using mobile equipment that is intermittently topside (e.g., aircraft, flight deck scrubber, and ground support equipment) (Wenzel *et al*., 2001a).

Two C-2 aircraft that are not included in the vessel's air wing were also onboard the vessel daily. The C-2 Greyhounds are used for Carrier Onboard Delivery (COD) (i.e., transporting Navy and civilian personnel to an underway aircraft carrier). To safely perform aircraft operations and maintenance, a maximum of 48 – 52 aircraft are on the fight deck at one time, the remaining aircraft are housed in the hangar deck. Aircraft are normally flown-off the vessel at the end of a deployment when the vessel is 150 nm to 300 nm from land to provide vessel's crew time to conduct the flight deck washdown and subsequent staging of equipment for offload. Therefore, all processes that support aircraft operation are concluded before the vessel transits within 12 nm (Wenzel *et al*., 2001a).

Aircraft embarked on CV/CVN 68 Class vessels are inspected and periodic maintenance/corrosion control is conducted on a 14- or 28-day [[edited for clarification for Navy]] cycle. Major maintenance actions are performed based on engine hours of operation. Leaks in the hydraulic lines are common; however, they are corrected as soon as they are detected. Depending on the weather conditions and location of the aircraft when the leak occurs, hydraulic fluid residue could contribute to deck runoff. All aircraft use MIL-PRF-83282D aircraft hydraulic fluid and MIL-PRF-81322F aircraft grease. Major maintenance actions performed on aircraft engines and airframes are conducted in the hangar bay located on the main deck (Wenzel *et al*., 2001a).

7.2.2 LHD 1 Class

The survey team conducted a survey of the aviation support systems aboard an LHD 1 Class vessel. The vessel carries five AV-8 Short Take-Off/Vertical Landing (STOVL) harrier aircraft operated and maintained by embarked Marine aviation combat element personnel. Aircraft are normally flown-off the vessel at the end of a deployment, thus providing the vessel's crew time to conduct flight deck washdown and subsequent staging of equipment for offload. All processes that support aircraft operation are concluded well before the vessel enters the 12 nm contiguous zone (Wenzel *et al*., 2001a).

Aircraft embarked on LHD 1 Class vessels are inspected and periodic maintenance/corrosion control is performed on a 7-, 14-, or 28-day cycle. Major maintenance actions are performed based on engine hours of operation, typically in 25 hr to 50 hr cycles. Engine and airframe maintenance actions are performed in the hangar bay located on the main level, one level below the flight deck. Leaks in the hydraulic lines that contain MIL-PRF-83282D hydraulic fluid are common however the crew corrects the leaks immediately, contains the spill, blocks the scuppers, and cleans up the spill using absorbent pads and rags. The waste generated is containerized and sent to the HAZMINCEN for proper disposal (Surgeon, 2001; Wenzel *et al*., 2001a). Depending on location of the aircraft when the leak occurs, hydraulic fluid residue could contribute to deck runoff.

7.2.3 Summary of Fixed Wing Aircraft Maintenance and Operations

Fixed wing air operations are conducted aboard CV/CVN 68 and amphibious assault class vessels. The products that have the greatest potential to contribute to deck runoff are MIL-PRF-83282D aircraft hydraulic fluid and MIL-PRF-81322F aircraft grease. The data for these processes are shown below. Aircraft are normally flown-off the vessel at the end of a deployment to provide the ship's crew time to conduct the flight deck washdown and subsequent staging of equipment for offload. Therefore, all processes that support aircraft operation are concluded well before the vessel enters within 12 nm.

Table 7-3— Estimated Quantities of Discharge for Aircraft Operations, Fixed Wing

Aircraft Type	Engine Cleaning Frequency (hours of operation)	Hydraulic System Capacity (MIL-PRF-83282D)
F-14	125	8 gal
F/A-18	150	4 gal
S-3	170	7.2 gal
EA-6B	150	7 gal
C-2	100	12 gal
E-2	100	12 gal
AV-8	Unknown	4 gal

Table 7-4— Potential Discharge Materials for Aircraft Operations, Fixed Wing

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Grease, MIL-PRF-81322F	Unknown	Mixture of paraffinic, naphthenic, and aromatic hydrocarbons	---	Unknown	Unknown	None
Hydraulic Fluid, MIL-PRF-83282D	Unknown	Synthetic hydrocarbon based oil	---	> 65	Unknown	None
		Ester based lubricant	---	< 35	Unknown	None

Table 7-5—Narrative Parameters for Aircraft Operations, Fixed Wing

Narrative Criteria	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Colloidal Matter	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists
Hardness	Unknown-not evaluated
Nutrients	None
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
Pathogens	None
pH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment. The information is based on survey team recollection and consensus.

7.3 FUEL TRANSFER SYSTEMS

Fuel transfer includes the supply of fuel to a vessel while pierside, fueling-at-sea (FAS) (See Figure 7-1), and the refueling and de-fueling of small boats onboard vessels. Underway refueling is performed outside 12 nm. In port refueling can be performed from either a permanent pier side fueling station, a floating fuel barge, or a pier side refueling truck. Three types of fuels are primarily used by Armed Forces vessels: (1) motor gasoline (MOGAS); (2) JP-5 (MIL-DTL-5624T); and (3) F-76 (MIL–F–16884J).

MOGAS is used to power spark ignition engines, predominantly found on outboard engines on small boats and combat vehicles. MOGAS is a low-end distillate with a high concentration of BTEX, monoaromatic (other than BTEX) and branched alkanes, lower concentration of n-alkanes, alkenes, cycloalkanes, and naphthalenes, and very low concentration of other PAHs (Potter and Simmons, 1998). Compensated MOGAS systems are installed on some amphibious vessels that require the transfer of large quantities of MOGAS for combat vehicles. Because of the low flash point and high risk of explosion from MOGAS, small quantities (e.g., used to supply small boats and craft) are stored in an outside fixed system described in NSTM Chapter 670, *Stowage, Handling, and Disposal of Hazardous General Use Consumables* (Navy, 1997c). The transfer of MOGAS between on deck systems and boats can occur anywhere inside or outside 12 nm. However, due to the extreme volatility of MOGAS and risk of vapor explosion, strict spill prevention and cleaning measures are in place (for details refer to NSTM Chapter 542, *Gasoline and JP-5 Fuel Systems* (Navy, 1997b)). Due to these spill prevention and cleaning measures, the amount of potential MOGAS constituents that may contribute to deck runoff is minimal and is limited to fuel residue.

In addition to its use as jet fuel for aircraft (see Section 2.61), JP-5 is used to power compression ignition engines of small boats and craft, and is an acceptable substitute for F-76 in vessel's compression ignition engines, gas turbines, and boilers. The transfer of JP-5 from on deck systems to boats can occur anywhere inside or outside 12 nm. The spill prevention and cleaning procedures outlined in NSTM 542 also apply to JP-5 spills, thereby limiting JP-5 contribution to deck runoff.

F-76, a type of kerosene distillate formerly known as diesel marine fuel (DMF), is the primary fuel used in Naval shipboard power plants including diesels, gas turbines, and boilers (Navy, 1996). Kerosene fuels are middle distillates with high concentrations of cycloalkanes and n-alkanes, lower concentrations of monoaromatics and branched alkanes, and very low concentrations of BTEXs and PAHs (Potter and Simmons, 1998). Traces amounts of F-76 may spill on the weather deck of a vessel during pierside fuel transfer operations or while fueling or de-fueling boats and craft powered by CI engines, and may contribute constituents to deck runoff discharges. However, FAS between vessels only occurs while underway outside 12 nm, and therefore it is not expected to contribute to deck runoff inside 12 nm.

Figure 7-1. Fueling at Sea

UNREP Fueling At Sea (FAS) Connection. Australian supply ship AOR 304 transfers 330,000 gal of fuel to U.S. Navy ship LHD 2. (Navy photograph by Stephanie M. Bergman.)

7.3.1 AOE 6 Class

AOE 6 Class vessels have three receiving and two transfer stations on the starboard side and three transfer stations on the port side. The vessel receives fuel through its three starboard side fuel receiving stations when pierside and has a capacity to carry 6.5 million gal of fuel. AOE 6 Class vessels use the two fuel transfer stations on the starboard side, and three fuel transfer stations on the port side for conducting FAS operations. During FAS operations, MIL-F-16884J marine diesel fuel or MIL-DTL-5624T jet fuel (JP-5) is pumped from a delivery vessel to a receiving vessel. The topside equipment for each FAS station is independently operated and controlled. Each FAS station has five winches; three of the winches have 800 ft of 0.875 in wire rope, and two have 800 ft of 0.75 in wire rope. Each winch is greased with 5 gal of MIL-G-24139A general-purpose grease. In addition, each FAS station has three saddle winches that control the tension of the saddle whips. Each saddle winch has 400 ft of 0.5 in wire rope lubricated with 2.5 gal of MIL-G-24139A. Prior to refueling operations, plastic bags filled with oil absorbent material are double-bagged and placed in all topside scuppers to prevent an overboard discharge in the event of a spill. Upon completion of each fueling evolution, the fuel hose “nozzle” is placed in a large (38 in wide by 24 in deep) drip pan immediately after it is retrieved onboard. The drip pan remains in place until no fuel leakage is detected; the contents of the drip pan are then poured into the contaminated fuel tank. Some spillage during hose disconnect is normal. The amount spilled, approximately 3 gal to 5 gal, is difficult to assess precisely because circumstances vary for each operation and the quantity of the spillage will likewise vary depending on these circumstances. The vessel’s crew ensures that no contaminants go overboard during FAS operations. One member of each FAS crew stands by during operations to clean up excess grease that drops from the wire rope to the weather deck. Although underway replenishment operations are conducted outside the contiguous zone, the potential does exists for the wire rope grease to be washed off during rainfall within 12 nm; therefore, MIL-G-24139A general purpose grease has the potential to contribute to deck runoff (Wenzel *et al*., 2001a).

7.3.2 DDG 51 Class

DDG 51 Class vessels have four refueling stations, that are not enclosed by a containment device. All fuel pumps and control systems are located below deck. In addition to locating the spill kit close to the refueling station, the crew takes the following precautions to prevent fuel from entering surrounding waters: (1) plastic bags are filled with water and placed in scupper drains during refueling operations, and (2) buckets are placed under hose connection points during refueling operations. However, residual contaminants resulting from refueling operations have the potential to contribute to deck runoff in the event of a significant spill or if the crew does not take precautionary measures (Wenzel, 2000b).

7.3.3 MCM 1 Class

MCM 1 Class vessels normally receive fuel from a shoreside refueling truck while the vessel is pierside. All fuel transfer pumping gear is located below decks and is common to both amidships (one port, one starboard) refueling stations. Above-deck valves and piping are enclosed within a containment device. The crew takes the following precautions to prevent fuel from entering surrounding waters: (1) threaded plugs are installed in the containment device to allow the controlled drainage of collected rainfall or fuel in the event of a leak; (2) an oil boom is placed around the vessel; (3) all deck drains are plugged during refueling operations; and (4) a spill kit is maintained onboard. Because the vessel does not carry or maintain fueling hoses onboard, the shoreside fuel depot provides equipment (fuel hoses equipped with cam lock quick disconnect fittings) required for refueling operations. As a result of the above measures, there is minimal potential for the fuel transfer system to contribute to deck runoff in the form of fuel residue trapped in the rough deck surface. A potential for spillage exists only when connecting or disconnecting the transfer hoses (Wenzel, 2000c).

7.3.4 WLM 175 Class

WLM 175 Class vessels are typically fueled from their operating pier via hoses. These vessels have the capability of transferring fuel from their storage tanks to other vessels. However, due to the vessels' operational zone, this capability has not been used to date. All fuel transfer pumping gear is located below decks, with the above deck valves and piping located in a container. The potential to contribute to deck runoff exists only when the residue from an inadvertent diesel fuel spill (when connecting or disconnecting the transfer hoses) becomes trapped in the rough deck surface (Wenzel, 2000a).

7.3.5 WPB 110 Class

WPB 110 Class vessels are typically fueled through hoses from a refueling truck while the vessel is pierside. Refueling stations are located on the forward section of the vessel's superstructure, both port and starboard. All fuel transfer pumping gear is located below deck and is common to both refueling stations, with the above-deck valves and piping located in a containment enclosure. The refueling stations are covered with canvas zip-down covers secured to the vessel with snaps to protect the equipment from the elements. In addition, the crew installed threaded plugs in the containment enclosure. During refueling evolutions, an oil boom is placed around the vessel and all deck drains are plugged. The area around the refueling station is lined with sandbags to assist in containment in the event of an accidental spill. The fuel depot personnel maintain spill kits on the pier. The potential to contribute to deck runoff exists when the residue from an inadvertent diesel fuel spill (when connecting or disconnecting the transfer hoses) becomes trapped in the rough deck surface (Wenzel, 2000d).

7.3.6 Summary of Petroleum, Oil, and Lubricants for Fuel Transfer Systems

The type of fuel transfer systems used on the vessels assessed varied in complexity and size. The fuel transfer system on AOE 6 Class vessels has the potential to contribute to deck runoff. The AOE 6 Class vessel has five very large stations used for fueling-at-sea (FAS) operations. Each station uses winch engines, wire rope, cable drums with sheaves, and control systems required to conduct refueling at sea operations. The potential to contribute to deck runoff does exist when residual fuel from an inadvertent spill becomes trapped in the rough deck surface during a DDG 51 fueling evolution; however, the potential is minimal and the crew exercises measures to prevent the spill from entering surrounding waters. The MCM 1, WLM 175, and WPB 110 are fueled from the pier and have containment structures surrounding the fuel receiving stations. The other vessels surveyed had receiving stations for fuel transfer and, as a general rule, do not transfer fuel to other vessels (Wenzel *et al.*, 2001a).

Table 7-6— Estimated Quantities of Fuel Transfer Systems Discharges

Vessel Class	Equipment	Potential Discharge Material	Amount Used
AOE 6	2400 ft 0.875 in wire rope	Grease, MIL-G-24139A	15 gal
AOE 6	1600 ft 0.75 in wire rope	Grease, MIL-G-24139A	10 gal
AOE 6	1200 ft 0.5 in wire rope	Grease, MIL-G-24139A	7.5 gal

Table 7-7— Potential Discharge Materials for Fuel Transfer Systems

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Multipurpose Grease, MIL-G-24139A	Unknown	Petroleum hydrocarbons	---	Unknown	Unknown	Unknown
Fuel, JP-5 MIL-DTL-5624T	Unknown	Cycloalkanes	---	Unknown	Unknown	None
		n-Alkanes	---	Unknown	Unknown	None
		Monoaromatics	---	Unknown	Unknown	Unknown
		Branched alkanes	---	Unknown	Unknown	Unknown
		Benzene	71432	Unknown	Unknown	None
		Toluene	108883	Unknown	Unknown	None
		Ethylbenzene	100414	Unknown	Unknown	None
		Xylenes	1330207	Unknown	Unknown	None
		PAHs	---	Unknown	Unknown	Elimination & Reduction
Fuel, F-76 MIL-F-16884J	Unknown	Kerosene	8008206	Unknown	Unknown	Unknown
MOGAS ASTM D4814	Unknown	Gasoline	8006619	100	Unknown	Unknown

Table 7-8—Narrative Parameters for Fuel Transfer Systems

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Colloidal Matter	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists
Hardness	Unknown-not evaluated
Nutrients	None
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
PH	Unknown-not evaluated
Pathogens	None
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

Note: At the time of the assessment, the need for the information in this table was not identified. The information is based on survey team recollection and consensus.

7.4 GROUND SUPPORT EQUIPMENT

CV/CVN 68 Class vessels and amphibious assault vessel classes (LHD) use ground support equipment (GSE) to maintain and move aircraft on the flight deck. The equipment uses several types of lubricants and greases that have the potential to leak and present a potential contributor to deck runoff. Although lubricants may leak from the equipment, they are cleaned up immediately, if and when they are detected. However, some maintenance materials may become trapped in the rough deck surface and enter surrounding waters within the contiguous zone, including oil, transmission fluid, hydraulic fluid, and antifreeze (Wenzel *et al*., 2001a).

7.4.1 AOE 6 Class

Minimal GSE is required to support aircraft operations onboard this vessel class. The GSE includes: one hydraulic service unit, 4 aircraft hydraulic jacks, one portable hydraulic test stand, and one nitrogen oxide cart. The GSE is inspected daily for proper operation (Wenzel *et al*., 2001a).

7.4.2 CV/CVN Class

Ground support equipment is comprised of vehicles and associated machinery to move, start, and load aircraft. This equipment is found primarily on large aviation and air capable vessels (e.g., CVN and LHD Class designation). Incidental leaks of hydraulic fluid (MIL-PRF-83282D) and engine oil (MIL-L-2104G) are the main deck runoff constituent sources from this equipment. Although leaks and spills are immediately cleaned if and when detected, the possibility exists for trace amounts to remain on deck and contribute to deck runoff discharge. However, some maintenance materials may become trapped in the rough deck surface and enter surrounding waters within the contiguous zone during a rainfall event including: SAE J2362 oil, Dextron II or III automatic transmission fluid, MIL-PRF-83282D hydraulic fluid, MIL-L-17331H hydraulic fluid, and AA-52624 antifreeze (Wenzel *et al*., 2001a).

Ground Support Equipment (GSE) carried onboard the CV/CVN Class vessel is illustrated in the following table.

Table 7-9— Ground Support Equipment, CV/CVN Classes

Equipment	Quantity
Mobile electric power plant	1
Gas turbine engine enclosure	1
Flight deck scrubber	1
Hydraulic servicing cart	1
Hydraulic power supplies	3
Maintenance stands	2
Aircraft jacks	3
Weapons loading hoist	1
Aircraft towing tractors	10
Crash and salvage crane*	1
Forklifts*	2
Flight deck fire trucks	1
Coolant oil servicing cart	1

*Also listed in Fire Assist Vehicle report section

The equipment listed in Table 7-9 was not all on the flight deck at one time. The amount of equipment topside was dependent on equipment availability and operational requirements.

7.4.3 LHD 1 Class

The LHD 1 Class vessel had the following equipment: four tow tractors, one tow tractor unit, four 6,000 lb. Forklifts, one 20,000 lb. crash crane, two pressure washers, one nitrogen oxide cart, one hydraulic service unit, one mobile electric power plant, one corrosion control cart, and one flight deck scrubber. This equipment was not all on the flight deck at one time; the amount of equipment topside was dependent on equipment availability and operational requirements (Wenzel *et al*., 2001a).

Although lubricants may leak from the equipment, they are cleaned up as soon as they are detected. However, some maintenance materials may become trapped in the rough deck surface enter surrounding waters within the contiguous zone during a rainfall event including: MIL-PRF-2104G lubricating oil, MIL-PRF-2105E lubricating oil, MIL-PRF-83282D hydraulic fluid, A-A-52624A antifreeze, MIL-DTL-17111C power transmission fluid, and Dextron III automatic transmission fluid (no Military Specification) (Wenzel *et al*., 2001a).

7.4.4 U.S. Army Vessels

JP-8 (very similar in chemical composition to JP-5 but with a larger range of alkanes) is used to power various cargo (e.g., Humvees and tanks) on Army vessels (U.S. Army, 1997; Potter & Simmons, 1998). This cargo may be stored above or below decks. The transfer of JP-8 from on deck systems to cargo is unlikely to occur while on the vessel. However, occasionally cargo may leak trace amounts of JP-8 on to the weather deck. Although spills are immediately cleaned up, some fuel may remain trapped in the rough deck surface and has the potential to contribute to deck runoff (Arredondo, 2001).

7.4.5 Summary of Petroleum, Oil, and Lubricants for Ground Support Equipment

CV/CVN 68 Class vessels and amphibious assault vessel classes use ground support equipment to maintain and move aircraft on the flight deck. The equipment uses several types of lubricants and greases that have the potential to leak and present a potential contributor to deck runoff (Wenzel *et al*., 2001a).

The survey team was unable to quantify the amount of material that has the potential to leak from the equipment and enter surrounding waters.

Table 7-10— Potential Discharge Materials for Ground Support Equipment

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Fuel, JP-5 MIL-DTL-5624T	Unknown	Cycloalkanes	---	Unknown	Unknown	None
		n-Alkanes	---	Unknown	Unknown	None
		Monoaromatics	---	Unknown	Unknown	Unknown
		Branched alkanes	---	Unknown	Unknown	Unknown
		Benzene	71432	Unknown	Unknown	None
		Toluene	108883	Unknown	Unknown	None
		Ethylbenzene	100414	Unknown	Unknown	None
		Xylenes	1330207	Unknown	Unknown	None
		PAHs	---	Unknown	Unknown	Elimination & Reduction
Motor oil SAE J2362	Unknown	Petroleum oils	---	Unknown	Unknown	Unknown
Hydraulic Fluid MIL-PRF-83282D	Unknown	Synthetic hydrocarbon based oil	---	> 65	Unknown	Unknown
		Ester based lubricant	---	< 35	Unknown	Unknown
Lubricating oil MIL-L-17331H	Unknown	Unknown	---	Unknown	Unknown	Unknown
Antifreeze A-A-52624A	Unknown	Propylene glycol	57556	Unknown	Unknown	None
Power transmission fluid, MIL-DTL-17111C	Unknown	Synthetic hydrocarbon	—	< 75	Unknown	Unknown
		Methacrylate polymers	—	< 25	Unknown	Unknown
		Tricresyl phosphate	—	< 1	Unknown	Unknown
Lubricating Oil, MIL-PRF-2104G	Unknown	Petroleum hydrocarbons	—	Unknown	Unknown	Unknown
Lubricating Oil, MIL-PRF-2105E	Unknown	Petroleum hydrocarbons	—	Unknown	Unknown	Unknown
Dextron Automatic Transmission Fluid Type II or III 9150-00-657-4959	Unknown	Highly refined base oils	—	> 85	Unknown	Unknown
		Additives	—	< 15	Unknown	Unknown
Fuel, JP-8 MIL-DTL-83133E	Unknown	Cycloalkanes	---	Unknown	Unknown	None
		n-Alkanes	---	Unknown	Unknown	None
		Monoaromatics	---	Unknown	Unknown	Unknown
		Branched alkanes	---	Unknown	Unknown	Unknown
		Benzene	71432	Unknown	Unknown	None
		Toluene	108883	Unknown	Unknown	None
		Ethylbenzene	100414	Unknown	Unknown	None
		Xylenes	1330207	Unknown	Unknown	None
		PAHs	---	Unknown	Unknown	Elimination & Reduction

Table 7-11— Narrative Parameters for Ground Support Equipment

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Colloidal Matter	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists
Nuisance Species	Unknown-not evaluated
Nutrients	None
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
Pathogens	None
pH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment. The information is based on survey team recollection and consensus.

7.5 ROTARY WING AIRCRAFT MAINTENANCE AND OPERATIONS

Rotary wing aircraft operate from aviation and air capable vessels that range from large aircraft carriers to USCG medium endurance cutters (WMEC 210 Class). Most rotary wing operations from Navy vessels occur outside 12 nm; with training operations occurring inside 12 nm. USCG vessels routinely operate rotary wing aircraft inside and outside 12 nm.

The rotary wing aircraft operation procedure that could produce deck runoff constituents is repairs to hydraulic lines. The aircraft hydraulic fluid used in rotary wing aircraft (MIL-PRF-83282D) contains more than 65 % of synthetic hydrocarbon base oil and less than 35 % of lubricant ester base. Although any hydraulic fluid that spills on deck is immediately cleaned, constituents may be entrained with deck runoff discharges inside 12 nm.

7.5.1 AOE 6 Class

The survey team conducted a survey of the aviation support systems aboard an AOE 6 Class vessel. The vessel carries two CH-46 helicopters operated and maintained by squadron personnel assigned to the vessel during underway periods. The helicopter’s primary mission is to transport cargo and personnel; its secondary mission is to perform search and rescue operations (Wenzel, 2000e). All aircraft usually disembark prior to entering within 12 nm; however, final deck cleaning and aircraft maintenance operations are sometimes conducted within the 12 nm zone. The following maintenance activities are performed on aircraft.

- The struts of the aircraft are greased every 7 days or 24 hours of flight operations using MIL-PRF-81322F.

- All access doors are greased every 56 days using MIL-PRF-81322F; however; if the aircraft are frequently deployed, the access doors are greased every 14 days.
- Rotor heads are greased every 7 days or 24 hours of flight operations using MIL-PRF-23827C.
- The engine oil, MIL-PRF-23699F, is changed every 100 hr of flight operations.
- The hydraulic system for the aircraft's flight controls is inspected for contamination every 400 hr of flight operations. The flight control system uses aircraft hydraulic fluid MIL-PRF-83282D.
- The search and rescue winch, which uses MIL-PRF-83282D hydraulic fluid, is inspected daily prior to each flight (Wenzel, 2000e).

7.5.2 CV/CVN 68 Class

For the CV/CVN 68 Class, seven SH-60 Seahawk helicopters carried onboard the vessel are operated and maintained by squadron personnel (Wenzel *et al*., 2001b). All aircraft disembark prior to entering the contiguous zone. As a result, discharges generated during aircraft cleaning and maintenance not conducted on the vessel are not subject to uniform national discharge standards.

The helicopters are inspected and periodic maintenance/corrosion control is conducted on a 14- or 28-day cycle. Major maintenance actions are performed based on engine hours of operations. All scheduled maintenance actions are performed in the hangar bay below the main deck and therefore these processes do not contribute to deck runoff. The SH-60 helicopter uses MIL-PRF-83282D aircraft hydraulic fluid (Wenzel *et al*., 2001b).

7.5.3 DDG 51 Class

The survey team conducted a survey of the aviation support systems aboard a pierside DDG 51 Class vessel. Rotary wing aircraft embark and disembark DDG 51 Class vessels when the vessel is outside 12 nm. Because the assessment was conducted pierside, air wing personnel were not aboard the vessel and the survey team was unable to gather specific information on air operations from this vessel class (Wenzel *et al*., 2001a). However, because of the similar nature of rotary wing operations between vessel classes, similar constituents are expected to that of other vessels that conduct rotary wing air operations.

7.5.4 LHD 1 Class

LHD 1 Class vessel had 24 rotary wing aircraft onboard during the survey team assessment: four CH-53 Sea Stallions; four AH-1 Sea Cobras; two UH-1 Hueys; and fourteen CH-46 Sea Knights. All of the aircraft, except two CH-46 helicopters, are operated and maintained by embarked Marine aviation combat element personnel (Wenzel *et al*., 2001c).

The helicopters are inspected and periodic maintenance/corrosion control is based on engine hours of operation in addition to a 7-, 14-, or 28-day cycle. Major maintenance actions are performed in the hangar bay below the main deck and therefore these processes do not contribute to deck runoff. As with fixed wing aircraft, leaks in the hydraulic lines of rotary wing aircraft are common and are corrected as soon as they are detected (Wenzel *et al*., 2001c).

7.5.5 Summary of Rotary Wing Aircraft Maintenance and Operations

Rotary wing air operations are conducted aboard a number of Navy and USCG vessels. The materials that have the greatest potential to contribute to deck runoff are MIL-PRF-81322F grease, MIL-PRF-83282D aircraft hydraulic fluid, MIL-PRF-23827C grease, and MIL-PRF-23699F engine oil. The data for these materials are shown below. As was previously noted, aircraft are normally flown-off the vessel at the end of a deployment when the vessel is well outside of the 12 nm zone to provide vessels' crew time to conduct the flight deck washdown and subsequent staging of equipment for offload.

Table 7-12— Potential Discharge Materials for Aircraft Operations, Rotary Wing

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Grease, MIL-PRF-81322F	Unknown	Mixture of paraffinic, naphthenic, and aromatic hydrocarbons	—	Unknown	Unknown	Unknown
Hydraulic Fluid, MIL-PRF-83282D	Unknown	synthetic hydrocarbon based oil	—	> 65	Unknown	Unknown
		Ester based lubricant	—	< 35	Unknown	Unknown
Grease, MIL-PRF-23827C	Unknown	synthetic ester	—	75 - 85	Unknown	None
		Lithium 12 hydroxystearate	7620771	10 - 15	Unknown	None
		Antimony dialkyldithiocarbamate	15890252	1-2	Unknown	None
		p,p'-Dioctyldiphenylamine	101677	1	Unknown	None
Engine Oil, MIL-PRF-23699F	Unknown	Polyol ester	68424317	0 - 90	Unknown	None
		Synthetic ester/fatty acids	68424339	0 - 90	Unknown	None
		Octylated N-phenyl-1-naphthylamine	68259369	< 2	Unknown	None
		p,p'-Dioctyldiphenylamine	101677	< 2	Unknown	None
		Tricresylphoshpate (mixed)	1330785	1	Unknown	None

Table 7-13—Narrative Parameters for Aircraft Operations, Rotary Wing

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists
Hardness	Unknown-not evaluated
Nutrients	None
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
pH	Unknown-not evaluated
Pathogens	None
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment. The information is based on survey team recollection and consensus.

7.6 PERFORMANCE OBJECTIVE AND ACTIVITIES

The objective for vessel, aircraft, and vehicle refueling is for the vessel's responsible party to prevent the discharge of anti-freeze compounds, fuels, hydraulic fluids, oils, greases, and other materials associated with vessel, aircraft, and vehicle refueling and lubrication that may negatively impact water quality. Activities that could be performed to meet this performance objective include, but are not limited to: minimizing vessel, aircraft, and vehicle refueling within 12 nm; and performing hose blowdown or applying back suction to drain the hose.

Depending on the vessel's mission operational area, vessels, aircraft, and vehicles may be refueled both inside and outside 12 nm. Although decks are immediately cleaned after spills, some fuel may remain trapped in the rough deck surface and contribute to deck runoff both inside and outside 12 nm. If a vessel, aircraft, or vehicle were refueled outside 12 nm, the amount of constituents on the deck that could contribute to deck runoff inside 12 nm would be reduced because most of any spilled fuel would be cleaned from the deck before the vessel is within 12 nm.

A hose blowdown occurs after the refueling is complete and the ship's fuel tank is secured from the aircraft. When performing a hose blowdown, the valve from the tank is closed and the remaining fuel is pumped to the aircraft, emptying all fuel from the hose. Back suction takes place when the fueling is complete; the transfer pump is reversed, and all fuel left in the hose is pumped into the shipboard fuel holding tank. Both of these methods prevent fuel from spilling on the deck, therefore reducing the amount of JP-5 contributing to deck runoff through hose disconnect spillage.

USCG vessels do not have the capability to perform a hose blowdown. However, USCG vessels use self-closing aircraft refueling nozzles that prevent the spillage of fuel. This type of nozzle locks into a corresponding receptacle on the aircraft. Different types of aircraft typically have different style refueling receptacles or fill ports. Because USCG vessels only carry two types of aircraft (HH-65 & HH-60), the use of an aircraft specific self-closing aircraft refueling nozzle is possible.

8.0 REFERENCES

Alexander, J. 2001. Email to K.T. Kacprzynski, Booz Allen Hamilton, Arlington, VA. from J. Alexander, Amsec, Virginia Beach, Virginia. Subject: Catapult Equipment Storage. 30 August 2001.

Baillargeon, J. 2001. Telephone call to J. Baillargeon, Pugeot Sound Naval Shipyard, Bremerton, WA from K.T. Kacprzynski, Booz Allen Hamilton, Arlington, VA, 20 February 2001.

Clayton Associates, Inc. 2001. The Dustmaster System [advertisement]. 2001.

EPA and DOD. 1999. Phase I Uniform National Discharge Standards for Vessels of the Armed Forces: Technical Development Document. US Environmental Protection Agency, Office of Water, Washington DC. EPA 821-R-99-001.

Federation of American Scientists. 1999. Military Analysis Network AOE 6 Supply Web Page. 23 January 1999. Federation of American Scientists. <http://www.fas.org/man/dod-101/sys/ship/aoe-6.htm>. Accessed 2 May 2002.

———. 2000. Military Analysis Network CVN-68 Nimitz-class Web Page. 8 January 2000. Federation of American Scientists. <http://www.fas.org/man/dod-101/sys/ship/cvn-68.htm>. Accessed 2 May 2002.

Grajek, P. H. 2000. Incorporation of Environmentally Compliant Catapult Lube Oil. Engineering Change Proposal. U.S. Navy Naval Air Warfare Center, Aircraft Division, Lakehurst NJ. ECP1-CAT-0013.

Keel, P. LTJG. 2001. Email to K. Kacprzynski, Booz Allen Hamilton, Arlington, Virginia. Re: CG Cutter and Boat Washing Procedures. 18 September 2001.

Kirkpatrick Wire Rope Lubrication System, 1999. Kirkpatrick Wire Rope Lubrication Systems Dynagard Wire Rope Lubricants. The Kirkpatrick Group. <http://thekirkpatrickgroup.com>. Accessed 20 September 1999.

Legge, B. 2002a. Email to T. Kwasigroh, Booz Allen Hamilton, Arlington, VA from B. Legge, Conley & Associates, Inc., Newport News, VA. Subject: ARMY VESSEL DECK RUNOFF DISCHARGE. 09 July 2002.

Legge, B. 2002b. Email to T. Kwasigroh, Booz Allen Hamilton, Arlington, VA from B. Legge, Conley & Associates, Inc., Newport News, VA. Subject: RE: Deck Runoff ChAR question. 09 July 2002.

Navy. 1996. Ship Fuel and Fuel Systems. Naval Ships' Technical Manual Chapter 541. Second Revision. U.S. Navy, Naval Sea System Command. S9086–SN–STM–010/CH–541 Rev. 2. 7 October 1996.

———. 1997a. NAVAIR Maintenance Instructions. 51-15ABB-4.1/1. March 1997.

———. 1997b. Gasoline and JP-5 Fuel Systems. Naval Ships' Technical Manual Chapter 542. Second Revision. Navy, Naval Sea System Command. S9086-SP-STM-010/CH-542 Rev. 2. 01 May 1997.

———. 1997c. Stowage, Handling, and Disposal of Hazardous General Use Consumables. Naval Ships' Technical Manual Chapter 670. Third Revision. Navy, Naval Sea System Command. S9086-WK-STM-010/CH-670 Rev. 3. 01 May 1997.

———. 1997d. Naval Message NAWCADLKE 200754Z NOV 97, ALRE Catapult Oily Waste Discharge Prevention. Naval Air Warfare Center Aircraft Division Lakehurst. November 1997.

———. 1998. Boats and Small Craft. Naval Ships' Technical Manual Chapter 583. Third Revision. U.S. Navy, Naval Sea System Command. S9086–TX–STM–010/CH–583 Rev. 3. 24 March 1998.

———. 1999. Environmental and Natural Resources Program Manual, OPNAVINST 5090.1B. U.S. Navy, Chief of Naval Operations, N45 Branch, Washington, D.C. 09 September 1999.

———. 2000. Requirement for Air Capable, Amphibious Assault, and Mine Countermeasure Ships to Operate Aircraft. Department of the Navy, Chief of Naval Operations. OPNAVINST 3120.35J. 27 June 2000.

Opet, S. L. Jr. 2000. A Nonpolluting Marine Lubricant for Steam Catapult Application. U.S. Navy Naval Air Warfare Center, Aircraft Division, Lakehurst NJ.

Potter, T.L, K. E. Simmons. 1998. Composition of Petroleum Mixtures. Total Petroleum Hydrocarbon Criteria Working Group Series, Volume 2. Amherst Scientific Publishers, Amherst, MA.

Surgeon, J., Jr. 2001. Telephone call to J. Surgeon, Jr., M. Rosenblatt & Son, Inc., Virginia Beach, Virginia from D. Kim, M. Rosenblatt & Son, Inc., Arlington, Virginia, 15 November 2001.

———. 2002. Email to D. Kim, M. Rosenblatt & Son, Inc., Arlington, Virginia from J. Surgeon, Jr., M. Rosenblatt & Son, Inc., Virginia Beach, Virginia. Subject: UNDS Deck Runoff Questions. 14 January 2002.

U.S. Army. 1997. Fuels and Lubricants Standardization Policy for Equipment Design, Operation, and Logistic Support. U.S. Army Headquarters, Washington, D.C. AR 70-12. 1 May 1997.

U.S. Coast Guard. 1998. Specifications for Fabrication of Ionomer Foam Buoys. U.S. Coast Guard, Ocean Engineering Division, Washington, D.C. Specification No. 450, Revision D.

———. 1999. Specifications for Fabrication of Steel Ocean Buoys. U.S. Coast Guard, Ocean Engineering Division, Washington DC. Specification No. 464, Revision G.

———. 2000a. Aviation Computerized Maintenance System Card 12002.0 for the HH-65 Helicopter. U.S. Coast Guard Headquarters, Washington, D.C. 01 December 2000.

———. 2000b. Specifications for Construction of Foam-Filled Unlighted Steel River Buoys. U.S. Coast Guard, Ocean Engineering Division, Washington DC. Specification No. 455, Revision D.

———. 2001a. Aviation Computerized Maintenance System Card 12002.0 for the HH-60 Helicopter. U.S. Coast Guard Headquarters, Washington, D.C. 01 April 2001.

———. 2001b. Coatings and Color Manual. Commandant Instruction M10360.3B. U.S. Coast Guard, Washington, D.C. 12 June 2001.

Volpe, R. 2002a. "Point Paper for UNDS Deck Runoff FIAR Development: Maintenance and Preservation of Buoys" 13 February 2002.

———. 2002b. "Point Paper for UNDS Deck Runoff FIAR Development: Vessels that accommodate two or less rotary wing aircraft," 13 February 2002.

Weeks, T.M. 2001. Email to J. Alexander, Amsec, Virginia Beach, Virginia. From T.M. Weeks, U.S. Navy, Naval Air Warfare Center, Lakehurst, N.J. Subject: Catapult Lube Oil Change Request. 06 June 2001.

Wenzel, et. al., 1999. Wenzel, M. L., Baillargeon, J. W "Ships Applicable to UNDS – Vessel Class Listing with Number of Vessels per Class (Active Vessels Only)" NSWCCD, 1999.

———. 2001a. Wenzel, M. L., Surgeon, J. D., Baillargeon, J. W., "Weather Deck Runoff *Discharges Constituent Mass Loading and Characterization of Deck Runoff*" January 2001

———. 2001b. Wenzel, M. L., Surgeon, J. D., Baillargeon, J. W., "Identification of Weather Deck Runoff Discharge Constituents Onboard a U. S. Navy CV/CVN Class Aircraft Carrier" NSWCCD-63-TR-2000/191, May 2001

———. 2001c. Wenzel, M. L., Surgeon, J. D., Baillargeon, J. W., "Identification of Weather Deck Runoff Discharge Constituents Onboard a U. S. Navy LHD 1 Class Amphibious Assault Ship" NSWCCD-TR-2000/192, May 2001.

Wenzel, M. L., 2000a. Wenzel, M. L., "Identification of Weather Deck Runoff Constituents Onboard a U.S. Coast Guard WLM (IDA LEWIS) Class Coastal Buoy Tender" NSWCCD-63-TM-1999/216, January 2000.

———. 2000b. Wenzel, M. L., "Identification of Weather Deck Runoff Discharge Constituents Onboard a U. S. Navy Arleigh Burke Class Guided Missile Destroyer" NSWCCD-63-TR-2000/01, February 2000.

———. 2000c. Wenzel, M. L., "Identification of Weather Deck Runoff Discharge Constituents Onboard a U. S. Navy Mine Countermeasure (MCM 1) Class Ship" NSWCCD-63-TR-2000/53, February 2000.

———. 2000d. Wenzel, M. L., "Identification of Weather Deck Runoff Discharge Constituents Onboard a U. S. Coast Guard Island Class (WPB) Patrol Boat" NSWCCD-63-TR-2000/249, July 2000.

———.2000e. Wenzel, M. L., "Identification of Weather Deck Runoff Discharge Constituents Onboard a U. S. Navy Fast Combat Support (AOE 6) Class Ship" NSWCCD-63-TR-2000/193, Nov 00

APPENDIX A – Class Specific Process Matrix

Class Specific Process	AOE-6	CV/CVN	DDG-51	LHD-1	MCM-1	WLM 175	WPB 110
Air Operations							
Fixed Wing		X		X			
Rotary Wing	X	X	X	X			
Aircraft Elevators		X		X			
Flight Deck Safety Nets	X	X	X	X			
Fire Assist Vehicles		X		X			
Ground Support Equipment	X	X		X			
Aircraft Launch & Recovery Equip.		X					
Recovery, Assist, Securing & Traversing System *							
Aircraft Washdown	X	X	X	X			
Aircraft Fueling	X	X	X	X			
Buoy Handling Systems						X	
Deck/Superstructure Maintenance & Preservation	X	X	X	X	X	X	X
Exterior topside surface washdown	X	X	X	X	X	X	X
Electronic Intelligence Systems	X	X	X	X	X		X
Search/Navigational Systems	X	X	X	X	X	X	X
Firemain Systems	X	X	X	X	X	X	X
Fuel Transfer Systems	X	X	X	X	X	X	X
General Housekeeping	X	X	X	X	X	X	X
Mine Handling Systems					X		
Ship's Boats/Ship's Boats Launching Systems	X	X	X	X	X	X	X
Stores Handling Systems	X	X	X	X			
Towing & Mooring Systems	X	X	X	X	X	X	X
Weapon Systems	X	X	X	X	X		X

*RAST installed on CG 49-73; FFG-8, 28, 29, 32, 33, 36-43, 45-61; DD 963-973, 975, 977, 978, 980-982, 985, 987-989, 991, and 992.